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LESSONS FROM AN AERIAL MINING
CAMPAIGN (OPERATION 'STARVATION')

Frederick M. Sellagar

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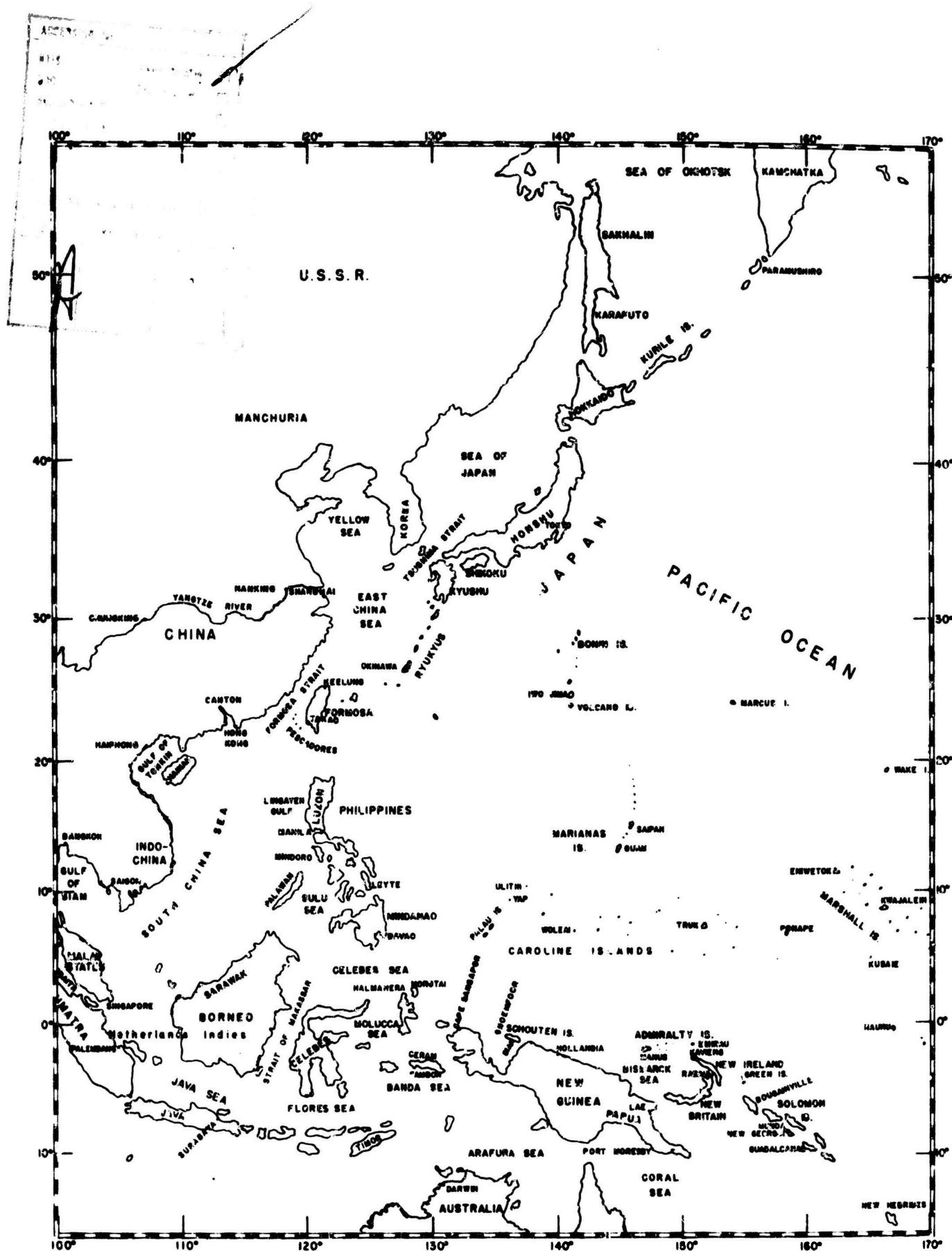
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A selective account of the B-29 aerial mining campaign conducted against Japan's Inner Zone (the homeland, north China, Manchuria, and Korea) during the last five months of World War II. The object is to provide a convenient overview of the operation as a whole, and of the strategic setting in which it occurred. The astonishing success of the campaign, which virtually paralyzed Japan's essential maritime traffic, was not anticipated by top military leaders. Although Japan's situation offered exceptional opportunities for this form of warfare, offensive aerial mining also may play a more important role in future conflicts that is now visualized. It could provide a unique capability in situations in which political constraints inhibit the use of the traditional weapons of aerial warfare. 90 pp. Ref. (NH)

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Lessons From an Aerial Mining Campaign (Operation "Starvation")

Frederick M. Sallagar

A Report prepared for
UNITED STATES AIR FORCE PROJECT RAND

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FOREWORD

This report is an outstanding analysis of the aerial mining campaign against Japan in World War II. Of particular significance and worth are the sections on "Aims and Results," and "Implications for the Future." They should be required reading for every military officer who is seeking a balanced perspective for the prosecution of war or limited war.

The phenomenal results of the B-29 aerial mining campaign against Japan have been too soon forgotten. As a matter of fact, few military persons ever learned that the total tonnage of Japanese shipping sunk and damaged (immobilized) by mines in the last six months of the war was greater than that which can be attributed to all other agents combined, including submarines, ships' gunfire, and Allied bombing. This was a remarkable accomplishment conducted by a relatively small portion of the Air Force. As the author points out, the so-called body count of ships sunk and damaged is often misleading. The important consideration was the actual impact on the Japanese desire to continue the war, and one can readily conclude from the interrogations of Japanese civilian and military leaders immediately after the war that the mining and its resultant immobilization of shipping was a major factor. The success of this campaign was a tribute to the flexibility of thought of those Air Force leaders who authorized the diversion of some aircraft from their traditional bombing role to that of aerial mining.

We may not know until later what impact the mining of Haiphong had on North Vietnam decisions concerning the war, but one thing is certain: the mining was effective in stopping shipments by sea.

As the author very wisely points out, one can easily imagine in this period of national revulsion toward war-like operations that aerial mining could be one of the few politically palatable/feasible operations acceptable to our government under some circumstances.

There is no doubt in my mind that should large-scale aerial mining be required in time of national emergency, the Air Force will have to accomplish the major portion of it. Although mining has been assigned

as a primary mission to the Navy, it is most likely that Navy aircraft, as in World War II, will be preoccupied with surface surveillance and antisubmarine warfare.

Because the mine is a "two-edged" weapon and a threat to friendly as well as enemy ships, it is essential that the Navy participate in the planning and technical aspects of mining operations. However, because mining operations are so often coordinated with and conducted much like other air operations, it is equally essential that Air Force personnel have a thorough understanding of aerial mining. At the moment there are only a handful of persons in any service who have such an understanding. The opportunities for becoming an expert are unlimited and offer a way to contribute to our national security.

Kenneth L. Veth
Rear Admiral, USN (Retired)

PREFACE

This account of a major aerial mining campaign in World War II reports on one of several mission-oriented studies concerned with the strategy and tactics of aerial interdiction. They are part of the broader, USAF-sponsored General Purpose Forces program under which Rand has been doing research on the conceptual, operational, and technical aspects of Air Force missions in the tactical area.

Several of these studies have examined current and projected capabilities for offensive mine warfare in possible future conflicts. One recent report^{*} deals with an important but little explored use of aerial mines for interdiction in situations where political constraints inhibit the use of more provocative weapons.

The present study of one of the most successful mining campaigns of the past was undertaken because it sheds light on a form of aerial warfare that is not well understood and may prove of greater concern to the Air Force than is now realized. Aerial mining is a *primary* function of the Navy and a *collateral* function of the Air Force. In some future conflict, however, the Air Force may once again be called upon to assume the principal responsibility for this mission, as was the case during the war in the Pacific. In the B-29 mining campaign, the Navy's role was to provide technical support to the Air Force, which was charged with the conduct of the campaign.

Offensive mine warfare is potentially too important to leave its development to a few dedicated mining specialists, or to a single service. If it is to be absorbed into the mainstream of military planning, aerial mining will require the same staff-wide attention, in the Air Force as well as in the Navy, that is now reserved for the more traditional uses of air power. This report is therefore addressed to those agencies of the Air Force whose responsibility it is to plan and prepare for different forms of aerial warfare in possible future conflicts.

^{*} J. W. Higgins and H. A. DeWeerd, *Land-Based Air, Sea Mines and Maritime Interdiction: B-52 Capabilities Illustrated in Mediterranean Limited-War Scenarios* (U), The Rand Corporation, R-1251-PR, July 1973 (Secret).

This study owes much to the excellent comments and suggestions from my Rand colleagues, Carl Builder, Edmund Dews, and Alfred Goldberg; I am sincerely grateful to them and hope that the finished product reflects the time and thought they put into their reviews of an earlier draft. I also wish to thank Eleanor Wainstein for the invaluable source material she retrieved in her search of the National Archives.

In order to keep footnotes to a minimum, a dual system of indicating sources was used in this report. Where no page citations were considered necessary, sources are indicated by an elevated number in parentheses in the text, corresponding to one of the numbered publications in the list of references. On the other hand, footnotes used to provide page citations or explanatory comments are indicated by conventional marks such as asterisks.

SUMMARY

The B-29 mining campaign against Japan's Inner Zone, which started at the end of March 1945, was preceded by a two-year mining effort directed mainly against conquered territories in Japan's Outer Zone. A brief review of this effort shows that aerial mines, whose first use in the Pacific was in early 1943, accounted for the major portion of this activity. The record was spotty and varied from theater to theater, depending on the attitudes of the commanders involved toward mining, and on their willingness to divert aircraft to this mission.

The genesis of the B-29 campaign deals with some of the obstacles that the advocates of aerial mining--a small group of Naval mine-warfare officers--had to overcome in order to get approval for this operation from higher authority. An important factor in the situation, apart from the general failure to appreciate the potential of mining, was the conflict over strategy between those who advocated a massive invasion of the Japanese home islands and those who believed in the less costly methods of aerial bombardment and naval blockade.

The account of the conduct of the campaign describes some of the operational features that are thought to be of more than historical interest in planning for mine warfare in the future. Among them is the role played by enemy countermeasures, and the opportunities that the minelayers had, but did not always seize, to thwart the mine-clearing effort.

The key section of the report is the one dealing with aims and results. It discusses the twin effects of ship sinking and ship immobilization, and the contribution made by each, insofar as the inadequate data permit. These two objectives are analyzed in some detail, including the preoccupation with the "body count" of ship losses. Also described are other, less familiar effects of the mining which contributed to the overall results of the campaign. Its total impact upon the disruption of Japan's maritime traffic and the consequent strangulation of her economy is illustrated in tables and graphs showing the decline in the imports of essential commodities.

The concluding section recapitulates some of the major lessons of the campaign and suggests their possible bearing upon the future. It points out the role the Air Force may be required to play in future mining operations, and the present anomalous division of this mission between the Air Force and the Navy. It emphasizes that mining could provide a unique capability in limited wars, where political constraints inhibit the employment of more destructive weapons, but this potential is unlikely to be fully realized without a change in the present attitudes toward mining.

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The planning, operational, and technical execution of 20th Air Force aircraft mining on a scale never before attained, has accomplished phenomenal results and is a credit to all concerned.

Fleet Admiral C. W. Nimitz, USN
Commander in Chief
U.S. Pacific Fleet

I. INTRODUCTION

The Air Force mining campaign against Japan which earned such high praise from the Navy was carried out by the Marianas-based B-29s of General LeMay's XXI Bomber Command under the code name of Operation STARVATION.* It began in late March 1945 and lasted, with some interruptions, until the war ended five months later.

It was not the first use of aerial mines in the Pacific, nor the first to be carried out by B-29 aircraft. A number of other American and Allied air forces, including the B-29s of the XX Bomber Command in the China-Burma-India Theater (CBI), had been laying mines in Japan's Outer Zone for over two years preceding the final campaign from the Marianas. But this last effort was the most concentrated and the most successful of its kind in the Pacific Theater; it was also the first to be directed against Japan's Inner Zone,** which hitherto had been inaccessible to Allied minelaying, except through occasional submarine forays.

The campaign was outstanding in many respects. More mines were laid in five months (over 12,000) than were dropped by all the other aircraft in the Pacific in more than two years (over 9000). The "phenomenal results" mentioned by Admiral Nimitz included at least 700,000 (and possibly as much as 1,250,000) tons of Japanese shipping sunk or

* I have tried to avoid this unfortunate code name by resorting to various circumlocutions or referring simply to "the mining campaign."

** The terms Outer Zone and Inner Zone are used in most reports and histories of the war in the Pacific but are never defined in precise geographical terms. The nearest thing to a definition is provided by Captain S. W. Roskill, RN, in his authoritative history of *The War at Sea*: "The Japanese tried to meet their import needs from what we may call the 'Inner Zone' of their Empire--the homeland, north China, Manchuria and Korea--rather than from the 'Outer Zone' where lay all their conquests of 1942" (Ref. 14, Part I, p. 233). This definition roughly corresponds to common usage which, however, was by no means uniform. One might argue, for instance, that the Inner Zone stretched farther along the island chain of the Ryukyus down to Formosa, and included the conquered mainland areas bordering the East China Sea.

severely damaged. Perhaps more important, much of the surviving ship tonnage was bottled up in mined harbors for prolonged periods while waiting for the mines to be cleared, which led to a virtual paralysis of Japan's essential maritime traffic.

High-ranking Japanese civilian and military officials who were interrogated by the U.S. Strategic Bombing Survey immediately after the war testified that the economic effects of the mining blockade had been as serious as those of the bombing attacks on Japan's urban-industrial areas:

Prince Konoye said that the aerial sinking of Japanese vessels and the B-29 aerial mining of Japanese harbors were equally as effective as the B-29 attacks on Japanese industry in the closing stages of the war when all food supplies and critical materials were prevented from reaching the Japanese home islands.*

The astonishing success of the B-29 mining campaign was not anticipated by the top military leaders of World War II. If it had been, offensive mine warfare on a large scale might have been undertaken earlier, and with more resources than were reluctantly allocated to it.⁽⁵⁾ It is even possible that the Joint Chiefs of Staff might have reconsidered the controversial plan for the massive invasion of the Japanese home islands, which was part of the agreed Allied strategy for the defeat of Japan.

One reason for this lack of foresight may have been that in the Navy as well as in the Air Force minelaying was held in low esteem and was always subordinated to the more glamorous combat missions. It got scant attention from strategic planners in peacetime and was only belatedly considered in wartime planning. In the words of the official history of the Army Air Forces:

At the beginning of World War II, neither the Navy nor the AAF was keenly interested in the use of the mine as

* Reference 3, p. 3. Prince Konoye, one of Japan's elder statesmen, had been premier during part of the war.

a strategic offensive weapon and consequently there was a serious lag in the mining program, both in the development of new weapons and in their employment.*

The Navy authors of the U.S. Strategic Bombing Survey report on the offensive minelaying campaign in the Pacific came to a similar conclusion:

There was at no time in the past war an over-all plan for a mining campaign against the Japanese, and as a consequence offensive mining was not included in the major strategy of the war.... Mines ... were orphans during the war ... much of the initiation and promotion of the minelaying campaign can be traced to the relatively small group of enthusiasts engaged in the work.**

The low regard of our wartime leaders for mine warfare does not seem to have been shaken by the demonstrated success of the B-29 campaign, for it is still evident in their post-war memoirs. Admiral King, who as Chief of Naval Operations had a special interest in the war in the Pacific, did not even consider the campaign worthy of mention.⁽¹⁶⁾ Neither did the President's Chief of Staff, Admiral Leahy.⁽¹⁵⁾ This neglect was not confined to naval officers alone. The wartime commander of the Army Air Forces, General H. H. Arnold, had devoted his life to winning greater recognition for the role of air power. The claims for the versatility of this new weapon were dramatically borne out by the unforeseen success of the B-29s in their novel role of minelaying. Nevertheless, he referred to this operation in his memoirs with a few casual sentences, such as "Another task given to the Twentieth Air Force, in conjunction with U.S. Navy submarines, was that of bottling up the Japanese ships in their home waters."⁽¹⁷⁾ Even General LeMay, under whose command the B-29 campaign was conducted, only devoted two short paragraphs to it in his memoirs.⁽¹⁸⁾

The unique conditions that made offensive mine warfare an exceptionally valuable instrument in the war against Japan may never recur.

* Reference 1, p. 662.

** Reference 3, p. 25.

But there could be a number of other situations in future conflicts, or in crises short of overt military conflict, in which aerial mines may provide an important, and perhaps indispensable capability that would be of direct concern to those charged with strategic planning for future air warfare.

It is primarily with that audience in mind that this selective account of the B-29 mining campaign against Japan has been prepared. Those more interested in the operational details of the campaign may refer to the sources cited in the list of references, and to other mission reports and unit histories.

The object here has been to provide a convenient overview of the operation as a whole, and of the strategic setting in which it occurred. This account, and the lessons that can be drawn from it, clearly indicate that we would be repeating the mistake made in World War II if we continued to neglect aerial mining in favor of the traditional weapons of aerial warfare. Offensive mine warfare has proved its value; its potential usefulness in the future is limited only by the lack of recognition from which this particular use of air power has unaccountably suffered.

II. AERIAL MINING IN THE PACIFIC BEFORE THE B-29 CAMPAIGN

The B-29 mining campaign from the Marianas will be seen in better perspective if we take a brief look at the mining effort in the Pacific that had preceded it. This earlier effort, apart from its direct results, had served as a valuable training period for the mining specialists whose experience was used to good advantage in the B-29 campaign. The British had been engaged in aerial mining in the European theater long before, but it is not as easy to transfer experience between forces of different nationality or between widely separated theaters.

Aerial mining did not begin in the Pacific until three and a half years after the Germans had first introduced this form of warfare, shortly after the outbreak of the war in 1939. The German use of aerial mines had come as a complete surprise to the British. They had been expecting mines to be laid by surface ships or submarines, but not by aircraft. Neither were they prepared at first to cope with the German magnetic influence mine, although they themselves had invented this type of mine in World War I.*

Prior to the B-29 campaign, the mining effort in the Pacific never came anywhere near the scale it had reached in the European theater, where the RAF dropped over 9000 mines** in the first five months of 1944--a figure that was exceeded only by the record total of more than 12,000 mines dropped by the B-29s in a similar five-month period against Japan. But the B-29 campaign occurred during the closing phase of the Pacific war and it had taken a long time to reach this scale of effort.

The first aerial mining mission in the Pacific was flown in February 1943 when the U.S. Tenth Air Force based in India dispatched ten B-24s--which had to be armed with British mines--to mine the Rangoon

* J.R.M. Butler, *Grand Strategy*, Vol. II, HMSO, London, 1957, p. 86.

** Reference 14, Part I, p. 289. The figure cited by Captain Roskill is 9637 mines. Because of slight discrepancies in the statistics given in different sources, I have often used round numbers in this report.

River in Burma. Minelaying by other means--surface ships and submarines--began at about the same time but never amounted to more than a small portion of the total mines used in the Pacific, most of which were dropped by aircraft, as shown in Table 1.

Table 1

MINES LAID IN THE PACIFIC
BY DIFFERENT CARRIERS

Carrier	Mines on Target
Submarines	658
Surface ships	2,829
Aircraft ^a	21,389
Total	24,876

SOURCE: Reference
3, Appendix B.

^aIncluding B-29
campaign.

The reason for the small number of mines laid by *submarines* is that their limited payload was usually devoted to torpedoes, which probably were regarded as producing better, or more easily observed, results. Mines were carried not so much by choice as by necessity, since there were periodic shortages of torpedoes.

... in the early months of the war, torpedo attacks on enemy shipping were awarded the priority.

Paradoxically, the torpedo shortage that developed as the war expanded implemented the long-awaited opportunity for minelaying. As there were not enough torpedoes to fully load all submarines going out on patrol, space became available for mines.*

* Theodore Roscoe, *United States Submarine Operations in World War II*, United States Naval Institute, Annapolis, Md., 1949, p. 179.

Despite its modest scale, the mining done by submarines was important. Prior to the B-29 campaign, it had been the only means of laying mines in the protected waters of Japan's Inner Zone and in some of the important harbors of the conquered territories. This had a dual effect, since the mining of harbors often forced Japanese shipping to remain in the open sea where it was exposed to direct attack.

As for the mining done in the Pacific by Allied *surface ships*, this also was a small effort, both absolutely and in relation to the vast minefields laid in the European theater. In the Pacific there was no comparable need for defensive minelaying, for which surface vessels are obviously better suited than for offensive mining in strongly defended enemy waters.*

What surface mining there was in the Pacific occurred almost entirely in the campaign for the Solomon Islands, where it served the tactical objective of sinking or immobilizing Japanese naval and merchant ships used to support the defense of the islands. No mines were laid by surface vessels in any of the other amphibious operations; the mines used in the long island-hopping advance across the Pacific were all dropped by aircraft. Why the Solomons campaign was different has been explained on the ground that there the minelayers had the unique advantage of being able to operate "in waters that were continuously under dispute by our own and the enemy's surface forces."⁽³⁾

This none too convincing explanation does not seem to have satisfied even its authors, for they also noted that "the failure to make more extensive use of surface-laid mines during the early Guadalcanal campaigns resulted in the loss of a favorable opportunity to hinder enemy naval actions seriously." The real trouble may have been the

* Whether there had been a real need for the enormous defensive mine barriers laid by the British Home Fleet in northern waters is questionable. The Admiralty seems to have tacitly admitted this when it disbanded the Minelaying Squadron in September 1943 after it had laid 110,500 mines. They had proved of greater hindrance to Allied shipping than to the enemy. As one historian noted, the British had not profited from their experience in the First World War in which they had laid a vast and equally unprofitable mine barrier across the North Sea. (Reference 14, Part I, pp. 61-62.)

lack of resources resulting from inadequate preparation in peacetime. Mine warfare always has been a stepchild; unless its value is appreciated, there never can be sufficient preparation for it.

Aerial mining was no exception in being handicapped by the consequences of peacetime neglect. It did not get started in the Pacific until well over a year after Pearl Harbor, and two more years elapsed before it reached the scale of the massive B-29 campaign from the Marianas.

Most of the aerial mining that preceded this campaign was directed against targets in Japan's Outer Zone, with the exception of the mines dropped by the USAAF in occupied China. The number of mines laid in this earlier, two-year effort--though far exceeding the mining done by surface vessels and submarines--was still substantially below the number dropped during the five months of the B-29 campaign. What may come as more of a surprise is that our Allies accounted for the lion's share of this effort. The contributions made by the four different air forces that participated in the aerial mining of Japan's Outer Zone--the U.S. Navy (including the Marines), the USAAF, the Royal Air Force, and the Royal Australian Air Force--are shown in Table 2.

Table 2

PARTICIPATION IN THE AERIAL MINING AGAINST JAPAN

Participant	Theater	Mines on Target
Royal Air Force	CBI	3,235
Royal Australian Air Force	Southwest Pacific	<u>2,498</u>
Total Allies		5,733
U.S. Navy (including Marines)	Central and South Pacific	687
USAAF ^a	CBI and Central Pacific	<u>2,834</u>
Total U.S. ^a		<u>3,521</u>
Total U.S. and Allies ^a		9,254
XXI Bomber Command	Central Pacific	<u>12,135</u>
Total aerial mining		21,389

SOURCE: Reference 3, Appendix B.

^aExcluding XXI Bomber Command.

Those who are accustomed to thinking of the war against Japan as predominantly an American show may find these figures difficult to explain. U.S. sources sometimes cite the shortage of aircraft and of suitable mines during the earlier stages of the war. These shortages may have been a handicap, but they could not be the whole explanation since the RAF and RAAF did their mining in the Pacific exclusively with American aircraft--B-24s and PBV-5s, respectively--and also used some American mines. One can only suspect, though direct evidence is hard to come by, that the different attitudes of the air force commanders involved may have played a part in this disparity of effort.

Most of the minelaying done prior to the campaign from the Marianas, regardless of which air force did the job, served either directly or indirectly to support Allied operations against Japanese-held territory in the Outer Zone. A relatively small portion of the effort was directed against the Inner Zone, where the American Fourteenth Air Force and the B-29s of the XX Bomber Command used mines with excellent effect to assist the hard-pressed Kuomintang forces in their battles against the Japanese invaders in China.

Some of the mining in the Outer Zone was clearly tactical, as was the case in the campaigns for the Solomons, the Marshall Islands, the Carolines, the Philippines, the Bonins, and Okinawa.* The mining of the Yangtze River and of some Japanese-held ports in China was in the same category, as was much of the minelaying done by the RAF in support of the Burma campaign. In other cases it would be a matter of definition whether the mining of Japanese harbors and anchorages in the Outer Zone should be called tactical or strategic.** Its main purpose was to interfere with the large amount of ocean traffic that was required to

*The first phase of the B-29 campaign from the Marianas was also devoted to the tactical purpose of assisting the invasion of Okinawa. It was only after the XXI Bomber Command was released from this task, more than a month later, that it was able to conduct the mining as part of the strategic air campaign as had been originally intended.

**Some observations on this subject will be found in two Rand Corporation reports: Edmund Dews, *A Note on Tactical Versus Strategic Air Interdiction*, RM-6239-PR, April 1970; F. M. Sallagar, *Operation "STRANGLE" (Italy 1944): A Case Study of Tactical Air Interdiction*, R-851-PR, February 1972.

supply the Japanese fighting forces in the conquered areas. The map of Japanese convoy routes shown in Fig. 1 gives an idea of the vast area that had to be covered. But the attack on convoy assembly ports also served to cut down traffic in both directions, to as well as from the Japanese home islands, since the mining reduced and immobilized the enemy's shipping capacity in general. The reduction in the imports of oil and other much needed commodities therefore had a strategic effect on Japan's ability to sustain the war effort. Nevertheless, it cannot be compared in scope or in results with the systematic mining campaign launched from the Marianas in the spring of 1945.

Before concluding this brief overview of the earlier mining activities, special mention should be made of the part played by operations in the CBI, and especially in China.

Of the total of over 2800 mines dropped by all USAAF units other than the XXI Bomber Command, more than a third--almost 1100 mines--were delivered by General Chennault's Fourteenth Air Force from bases in China. This is remarkable not just because of the logistical difficulties that had to be overcome to make this effort possible. What makes it even more noteworthy is that General Chennault had been willing to devote to the mining some of the precious tonnage that had to be painfully ferried to him over the Hump and that was needed for a variety of other uses. He felt that the results justified this decision, for "he credited mining as being one of the most important factors in stopping the Japanese drive into China in 1944. Enemy leaders have admitted that this fact is true."⁽³⁾

The minelaying activities of the Fourteenth Air Force declined when many of its forward bases were overrun by the Japanese. In August 1944, however, a powerful new weapon was added to Allied mine warfare capability in the CBI, when the B-29s of the XX Bomber Command, based in India, flew their first minelaying mission against the oil port of Palembang in Sumatra. The longer range and greater payload of the B-29s made it possible to drop heavy loads of mines on such important targets in Japan's Outer Zone as Singapore, Saigon, and Camranh Bay, which were thereby effectively eliminated from further use by the Japanese as convoy assembly points. These and other key ports in the

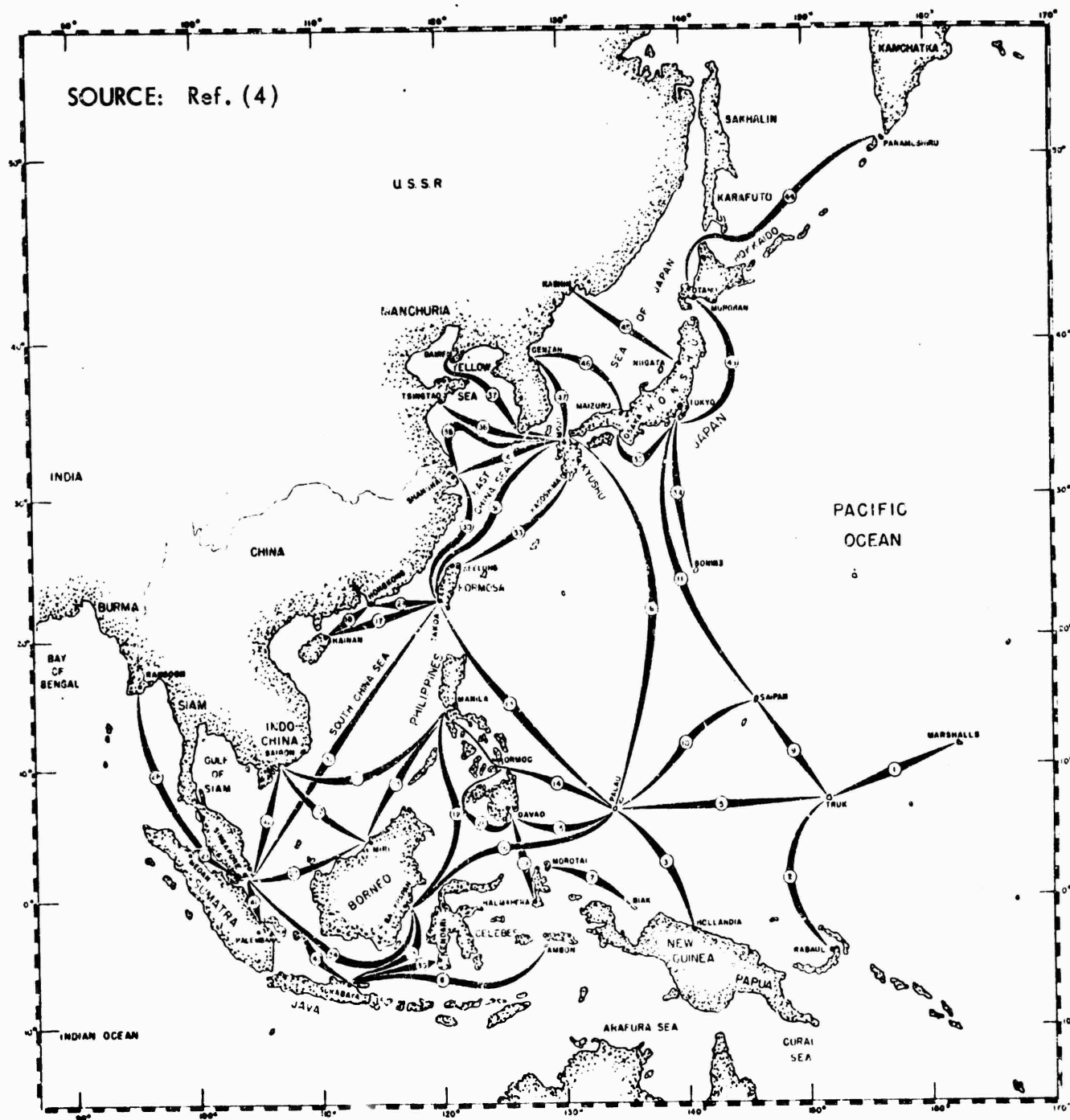


Fig. 1 — Japanese convoy routes (Source: Ref. 4)

enemy's ocean supply system had heretofore been too difficult to reach with B-24s from available Allied bases.

In addition to mining in the Outer Zone, the XX Bomber Command also was able to fill the gap that was left when the Fourteenth Air Force had to reduce its minelaying activities in China. The supply difficulties were enormous, for the B-29s operated from staging bases in China, for which POL and all other supplies had to be brought in over the Hump. But owing to their greater range, they were able to use bases farther inland that were still under Kuomintang control, and thus they could keep up the disruption of supplies for the Japanese armies that had been carried on by General Chennault. A painful blow was dealt to the enemy when the XX Bomber Command mined the Yangtze River approaches to Shanghai in March 1945 and thus closed the river to traffic for an extended period when the Japanese needed it most for supplying their forces in central China.

The mining activities of the XX Bomber Command were important not only because of the results achieved but because they were a forerunner of the great campaign from the Marianas, for which they served as a valuable training ground. Both were conducted under the leadership of General LeMay, who had taken over the XX Bomber Command in late August 1944, and then the XXI Bomber Command in January 1945. Some of the lessons learned in the CBI proved useful in the later campaign.

The mining missions flown by the XX Bomber Command had been large but spaced far apart, usually once a month during the full-moon period. This was contrary to the principle of more frequent mining in smaller increments and was only partly offset by fitting some of the mines with delayed arming mechanisms. In the campaign from the Marianas, only two pairs of missions, at the beginning of the first and second phases of the campaign, were on a comparably large scale (close to 100 aircraft in each mission). Most of the other missions were spaced in close intervals and were carried out by a single bombardment group, usually involving some thirty aircraft and sometimes fewer.

The minelaying done in the CBI stands out not only because of the part played in it by General Chennault's Fourteenth Air Force, as shown in the breakdown in Table 3, but because the total number of mines

dropped was almost 64 percent of the entire aerial mining effort in the Pacific, excluding the B-29 campaign from the Marianas. This impressive record was achieved despite the logistical difficulties and the unwieldy command structure in the CBI.

Table 3

AERIAL MINING FROM CHINA-BURMA-INDIA THEATER

Organization	Mines on Target
Tenth Air Force (AAF)	505
Fourteenth Air Force (AF)	1092
XX Bomber Command (AAF)	987
Royal Air Force	<u>3235</u>
Total CBI	5819
All other Pacific Theaters ^a	<u>3435</u>
Total aerial mining	9254

^aAll air forces except XXI Bomber Command.

The explanation was suggested by the authors of the U.S. Strategic Bombing Survey that has been the major source for this section of the study:

In general, the mine laying operations in the CBI were particularly favored in that they received direct encouragement from the theater commanders and their senior air force commanders.... This attitude was significant because it existed during a period when aerial mining was looked upon with scepticism by many.*

This difference in the attitudes toward mining helps to account for the disparity of effort between the CBI and other theaters. One of the skeptics seems to have been General MacArthur's air commander in the Southwest Pacific Area, General George Kenney. His own Fifth Air Force flew a single mining mission during the entire war, dropping

*Reference 3, p. 110.

a total of 24 mines. All the other mining in that theater was done by the Royal Australian Air Force, which did the best it could with old Catalina aircraft (PBV-5s) since General Kenney was unwilling to use his B-24s for this task. The comment of a naval mining expert who had been stationed in both theaters vividly illustrates the difference in the attitudes of the respective commanders:

In general, it has been a real pleasure to see the way the Air Forces in CBI have taken to mining. I believe that over in the SWPA General Kenney still will not permit any of his B-24's to do any minelaying although there is need for them. Their only operation was one we pulled off from New Guinea in June 1943. And that time it was only by scraping together makeshift crews and some spare planes that he allowed the operation to be executed. Wish there was some way you could put pressure on him from Washington to employ some of his B-24's in the work. Of course, he has done a wonderful job with his air force over there, but I am certain that he has also passed up some good opportunities to use them in laying aerial mines.*

* Excerpt from a personal letter written by Lt. Comdr. (now Rear Adm., Retired) Kenneth L. Veth, USN, to a friend in Washington in September 1944. At the time, Commander Veth was stationed in the CBI as a mining liaison officer on the staff of the Supreme Allied Commander, South East Asia. The letter is in the National Archives in Washington.

III. GENESIS OF THE B-29 MINING CAMPAIGN

The controversy over the value of aerial mining and over its proper role in the overall strategy of World War II is of more than historical interest. The attitudes that delayed and almost frustrated one of the outstanding campaigns of the war have lingered on to the present day. The following account of the difficulties that beset the genesis of the B-29 mining campaign may therefore serve to remind planners of the problems that could arise in a similar situation in the future.

The basic policy agreed upon by the top Allied leaders for the conduct of World War II was to give first priority to the defeat of Hitler's Germany. The war against Japan was to be carried on as best as possible with the resources that could be spared from the more urgent tasks in Europe. An important consequence of this policy--a policy which was understandably resented by some of the military commanders in the Pacific--was that it also curtailed the amount of thought and attention that the Allied leadership was able to devote to the war effort against Japan.

At least this was true until roughly the middle of 1944. By July of that year, the Allied lodgment in France had been made secure, and reinforcements were pouring in for an early breakout from the Normandy beachheads. Although the Germans were again offering stiff resistance after their initial setbacks, and much heavy fighting was still ahead, they were beginning to show the effects of the huge losses in men and materiel they had suffered in five years of unrelenting warfare. At last the Allied leaders could permit themselves to anticipate the end of the war in Europe, not in a matter of years but perhaps of months.

The time clearly had come to plan for the period when the vast resources tied up in the struggle for Europe would become available for transfer to the Pacific. The question was how these resources could best be employed to bring about the defeat of Japan at the earliest possible time.

STRATEGIES AT ISSUE

Toward the end of July 1944, President Roosevelt sailed in the cruiser *Baltimore* for Honolulu, where he was to meet with his senior field commanders in the Pacific, General MacArthur and Admiral Nimitz. The president was accompanied by his personal Chief of Staff, Admiral Leahy, but not by any other members of the Joint Chiefs of Staff, who usually attended high-level planning conferences of this sort. One member of the Joint Chiefs, Admiral King, who "happened" to be in Hawaii at the same time, had not been invited to be present at the meetings with the president which he describes in his memoirs under the acid chapter heading: "President Roosevelt Intervenes in Pacific Strategy."⁽¹⁶⁾ Whatever other reasons Roosevelt may have had, it is clear that he wished to get the personal opinions of his commanders on the spot, uninfluenced by their Washington superiors.

One of the major issues at the Honolulu conferences was the choice between two alternative strategies for defeating Japan: a massive invasion of the Japanese homelands similar to the Normandy landing, preceded by extensive aerial bombing and naval blockade; or a combination of intensified bombing and blockade alone, without invasion. That issue had been simmering in the military planning circles in Washington for some time prior to the president's trip to Hawaii.

The principal advocate of invasion was the U.S. Army, and especially its highly respected Chief of Staff, General Marshall. In his opinion there was no other quick way of bringing about the unconditional surrender of Japan to which the Allies had committed themselves. He favored the invasion of Kyushu as the first of two proposed major ground operations against the Japanese home islands, being "of the opinion that such an effort would not cost us in casualties more than 63,000 of the 190,000 combatant troops estimated as necessary for the operation."⁽¹⁵⁾

In line with this approach, the Joint Chiefs of Staff planners, among whom U.S. Army officers played a leading role, had drawn up ambitious plans for the invasion of the Japanese home islands. The operation was to be carried out in two stages; first the invasion of Kyushu (OLYMPIC), to be followed by a landing on the Tokyo plain on the

main island of Honshu (CORONET), which was to be the final blow that would bring about the Japanese defeat.

The senior commanders in the Pacific, Admiral Nimitz and General MacArthur, disagreed with Marshall's view, since it was apparent to them even as early as the middle of 1944, that an invasion of Japan was unnecessary. They saw Japanese offensive power already crippled through her naval defeats, the destruction of a large portion of her merchant fleet, and the loss of access to oil and other essential resources. The island-hopping campaign had deprived Japan of many of her conquests in the Outer Zone and was bringing Allied naval and aerial striking power closer and closer to the homelands. Some of the Japanese military leaders themselves felt that the loss of the Marianas in June and July of 1944 had sealed the doom of the Empire and had deprived it of any chance of averting complete defeat.

Among the most serious blows dealt to Japan was the highly successful attrition campaign against her merchant shipping. Despite strenuous efforts to replenish her losses through new construction and conversions, the merchant ship tonnage (excluding tankers) available to her had dropped from approximately 5.4 million tons at the start of the war to 3.2 million tons by the end of July 1944.⁽⁴⁾ But the reduction in tonnage is only a partial indicator of the economic strangulation that was being gradually imposed on Japan. The loss of important supply sources in the Outer Zone, and the traffic delays caused by the denial of convoy ports and the mining of harbors, added greatly to her difficulties in obtaining the resources needed for a constantly intensifying war.

The U.S. strategic bombing campaign against the Japanese home islands with the Marianas-based B-29s had not yet begun but would soon bring another powerful weapon to bear against Japan. Navy and Air Force leaders felt justified in expecting that an intensification of their two most promising methods of warfare--blockade and bombing--would force Japan to surrender even if her defensive strength was still great enough to exact a high price for an attempted invasion.

These views seem to have been forcibly impressed upon President Roosevelt during the Honolulu conferences. Since no minutes were kept,

we have only Admiral Leahy's eyewitness account of what happened.⁽¹⁵⁾ Leahy himself was among those most strongly opposed to the Army's plan for the invasion of Japan, but there is no reason to doubt his statement that the other conferees shared his position that an invasion of the home islands would be too costly in American lives and was unnecessary. The only difference between the two Pacific commanders seems to have been over the next major target in the Allied stepping-stone campaign. General MacArthur, for the well-known reasons, advocated the occupation of the Philippines as a first priority. Admiral Nimitz preferred to bypass the Philippines and to attack Formosa instead, as a means of bringing sea and air power closer to the Japanese heartland. Their differences were amicably resolved, with Nimitz agreeing to the attack on the Philippines, which was favored by Roosevelt as well as by MacArthur.

Admiral Leahy summed up the results of the conference as follows:

The agreement on fundamental strategy to be employed in defeating Japan and the President's familiarity with the situation acquired at this conference were to be of great value in preventing an unnecessary invasion of Japan which the planning staffs of the Joint Chiefs and the War Department were advocating, regardless of the loss of life that would result from an attack on Japan's ground forces in their own country. MacArthur and Nimitz were now in agreement that the Philippines should be recovered with ground and air power then available in the western Pacific and that Japan could be forced to accept our terms of surrender by the use of sea and air power without an invasion of the Japanese homeland.*

Despite the apparent agreement reached in Honolulu, the issue of whether or not to invade Japan remained unresolved, in the sense that no clear-cut decision for or against it had been made. The U.S. Joint Chiefs of Staff continued to press for the Army-preferred strategy, both within their own government and in their communications with the British.

The Americans had referred in June [1944] to the possibility of invading Japan, and this was confirmed by a telegram on

* Reference 15, p. 251.

11th July in which the Joint Chiefs of Staff announced their wish to restate the terms of the "overall objective" against Japan as follows:

"to force the unconditional surrender of Japan by
(i) lowering Japanese ability and will to resist by establishing sea and air blockades, conducting intensive air bombardment and destroying Japanese air and naval strength;
(ii) invading and seizing objectives in the industrial heart of Japan."

General Marshall added privately that this formula was designed to allow for an invasion of the Home Islands, which now seemed both feasible and certain. Ministers were therefore anxious to see the British Fleet in action with the American in the central Pacific.*

One would expect the invasion of Japan to have been a major issue at the Second Quebec Conference of the Allied leaders (OCTAGON) in September 1944 since its stated purpose was to map out a strategy for the closing phase of the war against Germany and Japan. In fact, this was not the case. Aside from problems connected with the war in Europe, the conference seems to have been preoccupied mainly with the role that British naval and air forces were to play in the war against Japan. The only major decision reached for the future strategy in the Pacific was to approve an operation against Leyte, in the Philippines, in late October 1944, two months earlier than originally planned.

The two alternative strategies for the defeat of Japan--invasion or intensified blockade and strategic bombardment--were left open for future decision. The third possible strategy--use of the atomic bomb when and if it should become operational--does not appear to have been seriously considered as a planning alternative. At that time (September 1944), the few Allied leaders who were privy to this most closely guarded secret were still too uncertain whether the bomb would work, what it could accomplish if it did, and how it should be used. The subject of the bomb was indeed brought up at the conference, for from it emerged the so-called Quebec Agreement under which the United States promised

* Reference 13, Vol. V, p. 498. Emphasis added.

to inform its British Allies before the bomb was dropped on Japan.* But the potential of this new weapon as a means of enforcing surrender was probably not appreciated by any but a few scientists directly connected with the Manhattan Project.

In the absence of a specific choice between the two alternative strategies, U.S. preparations for the final stage of the war against Japan proceeded in both directions at once, without the necessary emphasis being given to either. As we have just seen, the Joint Chiefs had failed to resolve the issue in the plan communicated to the British in June. Neither did they resolve it in a "revised" plan they issued on 9 September in preparation for the OCTAGON Conference, when they repeated their ambivalent statement of the "overall objective" in essentially the same terms. The only change in the September Plan, possibly as a concession to the Honolulu agreements, was that the JCS proposed to "retain flexibility" and "to exploit to the fullest the Allied superiority of naval and air power and to avoid, wherever possible, commitment to costly land campaigns."**

Failure of the Quebec Conference to resolve these uncertainties had far-reaching consequences. Among the most serious was that it provided no guidance on the allocation of priorities for men and materiel. Each service was therefore left free to preempt scarce resources for the particular war-fighting strategy it happened to favor; the Army for the invasion, the Navy for the antishipping blockade and carrier strikes, and the Air Force for strategic bombardment. All could be justified under the ambiguous JCS statement of the overall objective.

THE STRATEGIC BOMBING CAMPAIGN: SETTING PRIORITIES

Another consequence that is of particular relevance here was that the lack of agreement on a single strategy affected the planning for a full-scale aerial mining campaign against Japan. In September 1944,

* Len Giovannetti and Fred Freed, *The Decision to Drop the Bomb*, Coward-McCann, Inc., New York, 1965, passim.

** Reference 13, Vol. VI, pp. 206-207.

shortly before the Quebec Conference, General Arnold in his dual capacity as Commander of the USAAF and of the newly formed Twentieth Air Force, had asked the Committee of Operations Analysts^{*} for recommendations on the relative priorities that should be given to various possible target choices for the strategic bombing campaign that was about to be launched from the recently conquered bases in the Marianas. The COA was directed to base its recommendations on two alternative premises:

- I. That the defeat of Japan was to be accomplished primarily through strategic bombardment and blockade.
- II. That invasion of Japan would be launched in late 1945 or early 1946.

What were to be the preferred target priorities for strategic bombardment under these two premises?

The hurriedly drafted COA report was submitted on 10 October 1944.^{**} In essence, its recommendations were these:

Under Premise I: (Combined aerial and naval blockade; strategic bombardment.)

- A general antishipping campaign, "including a comprehensive mining campaign."
- An attack on the Japanese aircraft industry.
- An attack on Japan's urban industrial areas.
- A review of the target list upon completion of the attacks on the aircraft industry and urban areas.

^{*}The Committee of Operations Analysts (COA) was a small group originally composed of a little over a dozen high-ranking military and civilian officials representing the different services and civilian war agencies, and a few distinguished consultants. Its purpose was to study strategic bombardment targets. It had access to all military and civilian intelligence sources without going through regular channels and reported directly to General Arnold.

^{**}The following account is based on the summary report of the committee (Ref. 11). For the genesis and original membership of the COA, I have drawn on *The Army Air Forces in World War II* (Ref. 1, p. 26).

Under Premise II: (Combined aerial and naval blockade; strategic bombardment; invasion of the industrial heart of Japan.)

- An attack on the aircraft industry.
- An attack on urban industrial areas.
- Intensification of the attack on shipping "by all available methods, including mining by VLR aircraft where operationally feasible."

Two points in the report have a special bearing on our subject. The mining campaign, which was given first priority under Premise I, was relegated to third place under Premise II. The other point is that although the COA dutifully addressed itself to both premises and did not indicate a preference for either, the members clearly were taking it for granted that Premise II (invasion) was the operative objective. The report devoted a half page to Premise I and gave the remaining four and one-half pages to Premise II. Even in the recommendations under Premise I, the attack against the Japanese aircraft industry was followed by the phrase "to facilitate all subsequent operations." In all likelihood, this was meant to refer to subsequent ground-force operations against the Japanese homeland.

If this interpretation is correct, the COA was merely reflecting the prevailing views of the Washington military hierarchy, which was dominated by the towering figure of General Marshall. He and his staff planners were dedicated to the necessity of invading Japan and regarded all operations preceding the final assault as merely steps toward that goal. The extent to which Marshall's views had come to prevail, at least within the JCS, was demonstrated in a revision of their September memorandum, which was issued on 1 December 1944. In their new memorandum the invasion of Japan was no longer treated as a conditional operation:

- I. The United States Chiefs of Staff have adopted the following as a basis for planning in the war against Japan:

The concept of operations for the main effort in the Pacific is:

- A. Following the Okinawa operations to seize additional positions to intensify the blockade and air bombardment of Japan in order to create a situation favourable to:
- B. An assault on Kyushu ... in order to establish a tactical condition favourable to:
- C. The decisive invasion of the industrial heart of Japan through the Tokyo Plain.*

As remarked earlier, however, General Marshall's preference was not shared by the top commanders in the Pacific and was only reluctantly acquiesced in by his Navy and Air Force colleagues on the JCS. We have also seen that the JCS planning documents were so vaguely worded, and the failure to agree upon a strategy was so obvious, that each service (the Air Force, though not yet a separate service, had achieved a good deal of independence) was left free to interpret these documents as it wished. To the Army, the JCS endorsement of naval blockade and strategic bombardment merely meant that the Navy and the Air Force should be allowed to apply their favorite methods of warfare, provided that these preliminary operations were used to soften up the enemy in preparation for the invasion and did not interfere with the major objective.

Although the Navy and the Air Force ostensibly acted in compliance with the JCS memorandum, they regarded blockade and bombardment as potential war-winning strategies which, if applied with sufficient vigor, would be a substitute for the invasion and not a preparation for it. To this end, they bent every effort to intensify the operations in the Pacific which had already brought Japan close to defeat. Their main handicap was that their claims for the additional resources they wished to have for the job conflicted with the decision of the JCS to concentrate on preparations for the invasion. Ship bottoms for transport to the Pacific were one of the crucial items for which the Navy and the Air Force had to compete with the Army, since a vast amount

* Reference 13, Vol. VI, pp. 208-209.

of shipping was required by the Army to store up mountains of supplies for the attack on the home islands.

MINING THE JAPANESE HOMELAND

In order to intensify the blockade of Japan, which was showing such promising results, the Navy wished to supplement direct attacks on enemy shipping and ports with aerial mine warfare on a much larger scale than had hitherto been possible. One of the most profitable targets for such warfare was Japan's Inland Sea, where much of the traffic to and from the home islands was concentrated. This was where the greatest damage could be inflicted because Japan depended on this traffic not only for her war effort but for her very survival. Japan's Inner Zone, including the Inland Sea, had been heretofore inaccessible to Allied mining efforts, except for the small number of mines laid by submarines.

In July 1944, however, a new means of laying mines in Japan's own home waters seemed to be at hand. The Air Force B-29s, which were just becoming operational, offered both the range and the payload capacity to do the job either from existing bases in India and China or soon from new bases in the Marianas.

There was only one obstacle. The B-29s belonged to the Army Air Forces and had been specifically developed and built for the strategic bombardment of Japan. If the Navy favored blockade as the most promising war-winning strategy, the Air Force was equally devoted to strategic bombardment. The B-29s were controlled from Washington by the headquarters of the newly created Twentieth Air Force under the direct command of General Arnold himself. This unique command arrangement made Arnold responsible for their use only to the JCS, of which he was a member and where he could use his influence to control their assignment. He was not about to allow this valuable new weapon to be diverted from its intended purpose of strategic bombardment, let alone permit it to come under control of CINCPAC (Admiral Nimitz), as many officers on Nimitz's staff desired.

The strongest proponent of a massive and systematic aerial mining campaign with B-29s was the Naval Mine Warfare Section of Admiral

Nimitz's headquarters in Honolulu. These officers saw an opportunity to advance their cause when the Advance Echelon of the XXI Bomber Command stopped over in Hawaii on its way to the Marianas in order to set up a headquarters for B-29 operations on the newly conquered island of Saipan. A conference with the visiting Air Force officers was arranged by the Navy mining experts, at which they outlined their plan for a B-29 mining campaign against Japan. The Navy would provide and service the mines, in addition to furnishing whatever technical personnel, equipment, and information was required. The Air Force would be charged with actual delivery of the mines.

The Air Force visitors duly reported this proposal to their superiors in Washington on 7 July.⁽¹⁰⁾ It met with a mixed, but on the whole unfavorable, reception. The most vigorous opposition was voiced by the AC/AS Plans, General Lawrence S. Kuter, and the man most directly affected, General Haywood S. Hansell, Jr., who was to take command of the B-29s in the Marianas as soon as they were ready for deployment. Both men were firm believers in strategic bombardment.

But the Navy mine-warfare advocates persisted in their efforts. They pressed their case throughout September and October by submitting specific plans for a mine blockade of Japan to the Chief of Naval Operations, whose office passed them on to Headquarters, Twentieth Air Force.⁽¹⁰⁾

They were able to reenforce their arguments with the report of a subcommittee on Japanese shipping which was issued on 20 October to supplement the earlier report of the parent COA.* The subcommittee report constituted a strong endorsement of the Navy's plan for using B-29s to mine the Shimonoseki Straits--the funnel through which most of the traffic to and from the Inland Sea had to pass--as well as the Inland Sea itself and the principal ports on the islands of Honshu and Kyushu. It went far in claiming that this strategy would have decisive results. A large-scale mining campaign against these targets (the subcommittee proposed 5000 mines, or less than half the mines actually dropped during the campaign) would stop "practically all ocean-going

*Reference 12; for the earlier report, Ref. 11.

shipping to and from the Empire," would result in the "virtual destruction of the Japanese merchant fleet within a few months" if the ships ventured to run the blockade, and would "force the Japanese to abandon the Outer Zone and would hasten the time when they will no longer be able to sustain an effective defense of the home islands."*

The Under Secretary of War, Judge Patterson, deemed the subcommittee report of sufficient importance to send it to the Air Force on 22 October.** Unlike the earlier Navy proposals, the Patterson memorandum seemed to require a formal reply. It was prepared by General Kuter under date of 1 November 1944.⁽¹⁰⁾

The negative tone taken in the reply was characteristic of the attitude the Air Force was to maintain during the following months whenever the subject of aerial mining by B-29 aircraft was broached. General Kuter pleaded the target priorities recommended by the Committee of Operations Analysts in its earlier 10 October report, but was careful to cite them only in the order in which they had been listed under Premise II (invasion), namely attacks on the aircraft industry, or urban industrial areas, and on shipping. The Air Force professed itself in full agreement with these priorities, which it interpreted to mean that all available B-29 sorties should be concentrated first against the highest-priority target. This would consume the entire B-29 effort for several months to come. Since the XXI Bomber Command would not be fully deployed until 1 April 1945, this would be the earliest date when there would be sufficient sorties available to attack other target systems, such as enemy shipping.

The Kuter memorandum did acknowledge that mining operations might be useful as part of the attack on enemy shipping, but cautioned that "the limited scale of effort available to the Twentieth Air Force should not be diverted from its primary mission until that mission is accomplished." The "primary mission" undoubtedly meant strategic bombardment, first of the Japanese aircraft industry and subsequently of urban industrial areas.

* Based on a one-page subcommittee summary preceding the full report, which was not available to me (Ref. 12).

** I have not seen the Patterson memorandum.

The Navy, however, persisted in pressing its case. On 7 November 1944 Admiral Nimitz addressed a personal memorandum to General Arnold on the subject of "Plans Involving B-29 Aircraft Mining."⁽¹⁰⁾ It referred to the earlier Navy proposals on this subject, as well as to the subcommittee report of the COA,⁽¹²⁾ which had given strong endorsement to an early mining campaign against the Japanese homeland. The admiral proposed that the mining begin on the scale of 150 B-29 sorties per month during the period between January and March 1945 and be stepped up to around 1500 mines per month, starting in April, when new and more effective types of mines would become available. He also repeated the earlier Navy offer to provide the mines, support personnel, and expert advice.

General Arnold replied under date of 28 November,⁽¹⁰⁾ largely along the lines taken in the Kuter memorandum to Judge Patterson. He mentioned that the COA report of 10 October had recommended Japanese aircraft manufacturing plants as the first-priority target under Premise II (invasion) and pointed out that this premise conformed to the most recent directive of the JCS.* In order to destroy this target system, the Twentieth Air Force had to take advantage of the winter months when better weather made it easier to do precision bombing. In polite but rather vague terms, General Arnold suggested that his present capabilities were already strained and did not permit the scale of effort that the Navy proposed to divert to mining operations. He expected, however, that after the B-29 forces had been augmented, the "initial mining effort" requested by the Navy could be undertaken "at a later date."

General Arnold's own attitude on the use of the B-29s for aerial mining was probably not as negative as the tone of his letter implied. None of the Air Force officers involved, with the possible exception of Lieutenant General Millard Harmon,** welcomed the Navy proposals.

* This directive was officially issued a few days later, on 1 December.

** Commanding General, AAFPOA, as well as Deputy Commander of the Twentieth Air Force. Under the complicated command arrangement in the Pacific, AAFPOA (Army Air Forces, Pacific Ocean Areas) was charged mainly with the Air Force logistical and administrative functions in Admiral Nimitz's theater.

But Arnold and some of the Twentieth Air Force staff in Washington seem to have become gradually aware of the broader implications of the Air Force position on this subject and were willing to give B-29 mining a try, provided that it did not interfere with the strategic bombardment of Japan. The prospect of winning a new role for the Air Force may have influenced their attitude. The fear of what might happen in case of an outright refusal may have been another, and more potent, factor.

Yet in light of the spectacular results of the B-29 mining operations later, it is ironical that the decision to co-operate with Nimitz came not from any great liking in the AAF for mining but rather from the sort of logic that often colored interservice comity during the war--the fear that otherwise the AAF might allow "a possible major usage of long-range aircraft to develop, by default, into a matter of special interest to the Navy."^{*}

Whatever the reason, the plans for aerial mining by B-29s began to take firmer shape. When General Harmon alerted the Commanding General, XXI Bomber Command (General Hansell) to these plans, the latter protested strongly, but his protests were overridden, and on 22 December he was formally directed to prepare for B-29 mining to start on 1 April 1945 on the scale of 150 to 200 sorties per month.^{**}

The planning for what was eventually to become the most massive mining campaign of the war had begun, but there was still no enthusiasm for the project on the part of the Air Force. On 9 January 1945, almost three weeks after the planning directive had been sent to the XXI Bomber Command, the AC/AS Plans issued a policy memorandum on aerial mining which left it uncertain whether the campaign would be carried out at all. The memorandum stated that in the late spring or summer, after the B-29 forces had been augmented and the flying weather over Japan had deteriorated, "it is believed that mining operations *may be* carried out by very heavy bombers from the Marianas."⁽¹⁰⁾ The words "may be" were underscored.

^{*} Reference 1, p. 664.

^{**} The directive is cited in an internal air staff paper signed by the Deputy Chief of Staff of the Twentieth Air Force.⁽¹⁰⁾

There were a number of reasons for the continued Air Force opposition to the use of B-29s for aerial mining. Failure to appreciate the importance of the shipping blockade of Japan, and reluctance to undertake what the Air Force considered to be the Navy's job, were among them. Apart from any other considerations, however, the Air Force regarded it as axiomatic that its most urgent task was to destroy the Japanese aircraft industry as a means of winning air superiority over Japan.

The XXI Bomber Command had suffered substantial attrition in the first few months of its strategic bombing campaign against the home islands. The tempo of that campaign was to be stepped up greatly as additional B-29 wings arrived in the theater and sufficient forces became available to permit the contemplated large-scale attacks on urban-industrial areas. It was therefore considered essential to whittle down enemy air opposition as a matter of highest priority, not only to cut down losses in bombing attacks but also "to facilitate all subsequent operations."

These operations included the scheduled ground-force invasion of the Japanese home islands. Following the strategy employed in Europe, a massive invasion was not to be risked until enemy air opposition had been eliminated or greatly weakened. This had been successfully done before the Normandy invasion, in which the Allies enjoyed complete air superiority as the result of the long campaign against the German air force and its supporting industry. So long as the JCS plan for the invasion of Japan remained the operative strategy, the Air Force could legitimately argue that it must concentrate first on eliminating a major source of enemy opposition.

But this argument could be stretched too far, as when it was claimed that "any sustained air operations over Japan, bombing or mining, demanded first the destruction of the sources of Japan's air power."* This may have applied to the daylight precision bombing of pinpoint targets, which required formation flying and great delivery accuracy. But it did not apply to mining operations which could be

*Reference 1, p. 664.

carried out at night, with aircraft flying singly, and in which delivery errors of as much as one to two miles were quite acceptable. As it turned out, B-29 losses from enemy opposition during the mining campaign were negligible and probably would have been small even if the minelaying had been done before Japanese air opposition had been whittled down through General LeMay's vigorous campaign in the preceding months.

The Air Force response to the demand for aerial mining may have been perfunctory, but once events had been set in motion by the issuance of the first planning directive, they followed their own course and gained momentum as one step led to another. In the middle of January 1945, General Hansell was replaced by General LeMay as commander of the B-29s in the Marianas.* LeMay was no more enthusiastic about using the B-29s for mining than his predecessor had been, but he was under strong pressure from Admiral Nimitz's staff and had to follow the directive issued to the XXI Bomber Command. Being a man who did not like to do things by halves, he agreed with General Harmon that if there had to be mining, the scale of effort proposed in the earlier directive was inadequate. On 26 January he submitted his own mining plan to Washington. It called for the delivery of 1500 mines in April--the figure originally proposed by Admiral Nimitz--and for the use of an entire wing of B-29s, instead of a single group as General Hansell had planned.⁽¹⁾ In February 1945 the newly arrived 313th Wing on the island of Tinian began to train for the mining campaign. Operation STARVATION was under way.

* General Hansell was relieved, not because of his opposition to mining, which was shared by his replacement, but because General Arnold was impatient with the poor results achieved in the bombing of the Japanese aircraft industry during the preceding months. This had been due to a variety of causes over which General Hansell had little or no control.

IV. CONDUCT OF THE CAMPAIGN^{*}

What redeeming features the B-29 mining campaign may have had in Air Force eyes derived from the fact that it had been originally intended to serve a strategic objective. It was to complement the bombing attacks on Japan by starving her of essential supplies and thus hastening her surrender, preferably without the need for invasion. Hence the code name Operation STARVATION.

As the time for the campaign was approaching, however, another objective assumed precedence. The minelaying was scheduled to begin on or shortly before 1 April. But this was also the date set for the attack on Okinawa, which was rightly expected to be one of the most difficult and costly operations of the war in the Pacific. Admiral Nimitz wished to utilize the unique long-range capability of the B-29s to provide reconnaissance and to fly bombing missions against the Japanese air bases on Kyushu and Formosa. Another form of tactical support would be the mining of the Shimonoseki Strait. Closure of this vital passage would bottle up the Japanese naval forces in the Inland Sea and prevent them from being used in the defense of Okinawa.

Throughout the war, the USAAF--and the RAF Bomber Command as well--had generally been opposed to the use of strategic bombers for tactical support. The need had to be great before the Air Force would allow the B-29s, which were regarded as the ultimate strategic weapon, to be diverted for tactical use.

Both at Washington and Guam the AAF had showed a disinclination to divert the B-29's to tactical support of ground or sea operations--for example, Arnold and Hansell had resisted MacArthur's efforts to have XXI Bomber Command strike Okinawa airfields to aid his Luzon campaign.**

^{*}This section leans heavily on the *Phase Analysis of Strategic Mining of the Japanese Empire (Operation STARVATION)*, prepared by the XXI Bomber Command, from which most of the facts used here are taken. The authors of that report had been directly involved in the planning and direction of the mining effort by the 313th Wing.

^{**}Reference 1, p. 571.

Under the terms of the JCS directive governing Twentieth Air Force operations, the theater commander (Nimitz) was entitled to take over control of B-29 employment when confronted with an emergency situation.* But the invasion of Okinawa (Operation ICEBERG) was a special case. Anticipating the difficulties that lay ahead, General Arnold had gone beyond the minimum he was required to do by assuring Admiral Nimitz that the B-29s would be available to him, not just for use in an emergency, but whenever he thought that they could have a decisive effect upon the success of ICEBERG.**

Acting upon these instructions, the XXI Bomber Command had started several weeks before the invasion to work out plans with CINCPAC and AAFPOA for the tactical support of ICEBERG. In advance of the landing and during the critical period of the invasion, the B-29s from the Marianas were to fly reconnaissance missions, bomb the Kyushu airfields, and close the Shimonoseki Strait with 1500 mines. The mining was scheduled for the last week of March, on the eve of the Okinawa invasion.

A glance at the map (Fig. 2) will show why Shimonoseki was a logical choice for the initial mining effort. As the sole western exit from the Inland Sea, it provided the only route to Japan's Outer Zone that was relatively sheltered from aerial observation and from attacks by Allied submarines and carrier aircraft. The eastern passages to the Pacific--Bungo and Kii straits--had become perilous and were used only in emergencies, since ships attempting these passages were often spotted and attacked by U.S. naval forces.

Admiral Nimitz had counted on this situation when he hoped that the mining of Shimonoseki would provide tactical support for ICEBERG. He was not disappointed. In early April, after the strait had been closed

* A similar escape clause had been included in some European command arrangements as well, as a safeguard for the theater commander who usually had little control over the operations of his semi-independent strategic air components. There were notable exceptions, such as the period prior to the Normandy invasion, when the entire air effort, strategic and tactical, was controlled by General Eisenhower.

** This cooperative attitude may have been somewhat influenced by the fear that otherwise the Twentieth Air Force might lose the B-29s to Admiral Nimitz.

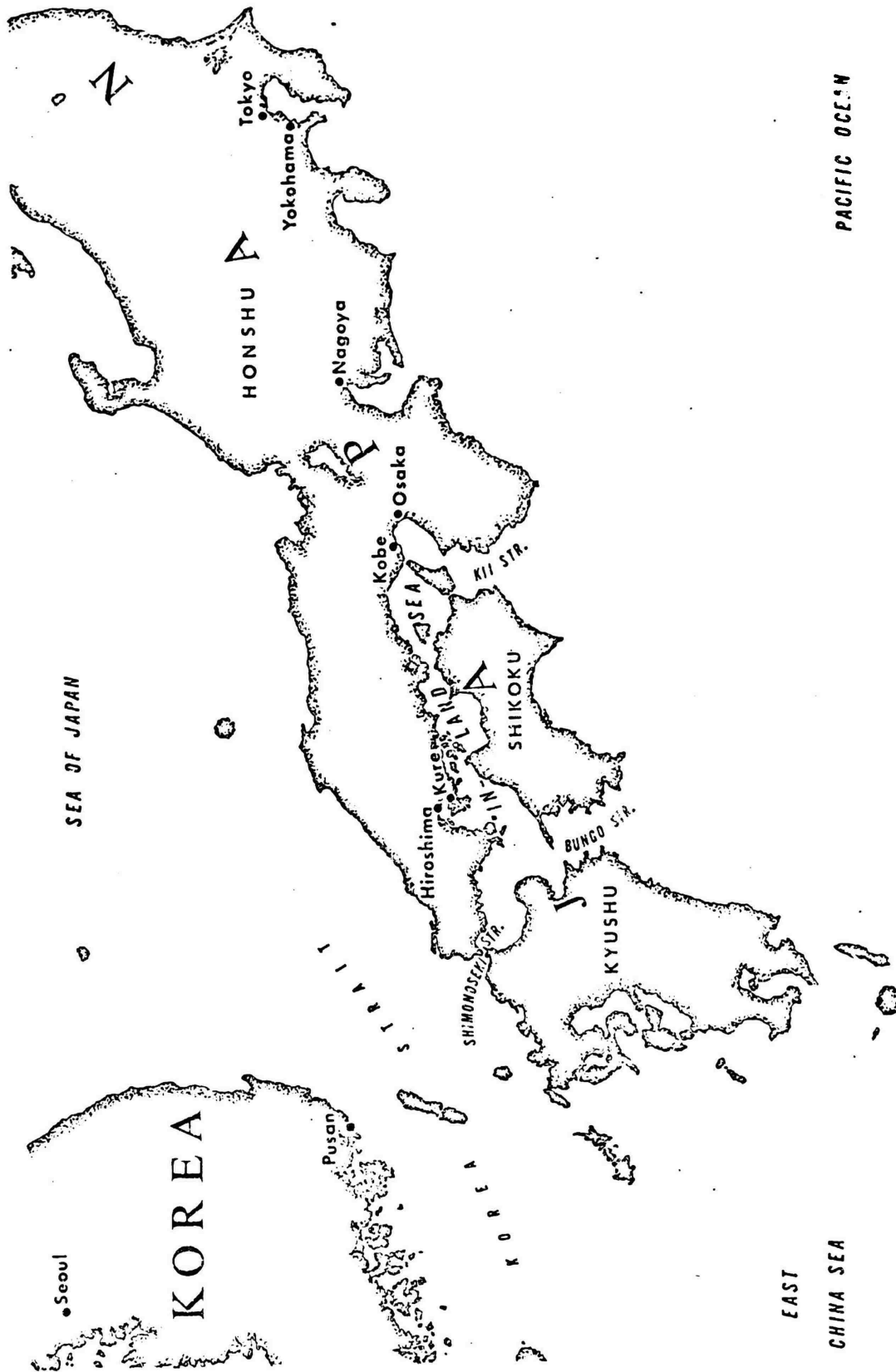


Fig. 2 — The Inland Sea and its approaches

by the B-29 mining campaign, some remnants of the Japanese fleet risked a sortie from their base at Kure, on the Inland Sea, in order to come to the aid of the beleaguered garrison in Okinawa. Closure of Shimonoseki forced the naval task force to attempt the dangerous Bungo passage to the east. The sortie ended in disaster. The task force was located and put out of action by U.S. carrier planes. The toll of ships sunk included the superbattleship *Yamato*, the pride of the Japanese Navy.

Although the choice of Shimonoseki as the initial target for the mining was prompted mainly by tactical considerations, closure of the strait remained a prime objective of the mining campaign after the emergency at Okinawa had passed. There were important strategic reasons as well for interdicting the use of this vital passage.

Japan's inadequate rail transportation system had always forced her to depend on waterborne traffic for the bulk of her transport needs. Much of that traffic was routed through the Inland Sea, along which some of Japan's important industrial ports were located. She became even more dependent on that route after Allied carrier attacks had made the populous east-coast cities unsafe for merchant ships to enter. Supplies for these cities had to reach them by rail from the Inland Sea ports, except for the relatively small amount landed at the inadequate harbors of northwest Honshu. The Inland Sea had therefore become the principal gateway route for the traffic that was essential not only to sustain Japan's war effort but to supply her civilian population with food and other vital necessities. Since the Shimonoseki Strait offered the only remaining passage to and from the Inland Sea it was still reasonably safe, it had become the bottleneck through which a major portion of Japan's waterborne traffic had to be funnelled. Clearly, continued closure of the strait would be of the greatest strategic importance.

PATTERN OF OPERATIONS

The mining campaign from the Marianas was inaugurated on 27 March 1944 when the 313th Wing of the XXI Bomber Command flew its first mine-laying mission against Shimonoseki. It was a maximum effort for the

recently arrived wing; 105 air craft were airborne, although only 92 dropped their mines in the primary target area. The mission was repeated on the night of 30 March with 94 aircraft airborne, of which 85 successfully completed their task.

The minefields laid in these two missions accomplished all that had been hoped for. On the basis of reconnaissance it was estimated in the theater that traffic through the strait had been reduced to 25 percent of normal.⁽²⁾ Few large vessels braved the mined passage or attempted the alternate routes that had proved disastrous to the naval task force. The planners in the Marianas believed that Shimonoseki would remain effectively blocked for ten days to two weeks. During that period only small-scale mining forays would be needed to close gaps in the minefields and to sow mines in the Kure-Hiroshima area within the Inland Sea where Japanese naval units were stationed.

This was one reason why only five small mining missions were flown during all of April; a total of 50 aircraft were airborne during these missions. Another reason was that the 313th Wing was preoccupied with other tasks during April. It participated with the other Wings of the XXI Bomber Command in the large-scale incendiary raids against Japan that had begun with the spectacular fire bombing of Tokyo on 9 March. During the second half of April the wing was required to devote almost its entire effort to attacks on the Kyushu airfields, which the theater commander had ordered because of the critical situation at Okinawa created by the Kamikaze threat to the invasion forces. It was not until 11 May that Admiral Nimitz judged the situation sufficiently under control to release the XXI Bomber Command from its commitment to provide tactical support for ICEBERG.

Even before that date, however, the 313th Wing was able to initiate a new phase in its mining campaign. The objectives and targets of this and other phases of the campaign are shown in Table 4.

The second phase, unlike the first, was aimed solely at the strategic objective of establishing an "Industrial Center Blockade." The new A-6 pressure-type mine had become available in limited amount for this effort. It was considered to be unsweepable. This phase of the campaign was brief, consisting of two full-wing missions on 3 and 5 May,

Table 4
OBJECTIVES AND TARGETS OF B-29 MINING CAMPAIGN

Phase	Date	Objective	Target and Action	Remarks
First	27 Mar- 2 May	Support Okinawa invasion	Mine Shimonoseki Strait, Kure and Sasebo naval bases, Hiroshima P.O.E.	Japan's naval task force headed by battleship <i>Yamato</i> forced to exit Bungo Strait, detected and sunk.
Second	3 May- 12 May	Blockade industrial centers	Remine Shimonoseki, mine Kobe, Osaka, Inland Sea passages, Tokyo, Nagoya	Recce shows ship passages through Shimonoseki reduced to less than one-tenth. First use of pressure mine.
Third	13 May- 6 June	Blockade northwest Honshu and Kyushu	Remine Shimonoseki, mine major harbors of northwest Honshu and Kyushu	Decision to use single group missions. First use of low-frequency acoustic mine.
Fourth	7 June- 8 July	Intensify Honshu, Kyushu blockade	Remine previous targets, add secondary and tertiary harbors of northwest Honshu and Kyushu	Single group missions every second night. Ship traffic in industrial ports virtually stopped. Only Shimonoseki, Kobe, Osaka remined.
Fifth	9 July- 15 Aug	Total blockade	Maintain blockade of Shimonoseki, northwest Honshu and Kyushu; mine all Korean ports	Critical shortage of food and supplies. Mining closed access to ship repair yards.

SOURCE: Reference 2.

with close to 100 aircraft airborne in each mission. The targets were the Inland Sea ports of Kobe and Osaka, shipping routes within the Inland Sea, and the harbors of Tokyo and Nagoya. Shimonoseki was remined.

The net was tightened further in the remaining three phases of the campaign. Closure of Shimonoseki was maintained through periodic remining, the entire Inland Sea was made increasingly unsafe for Japanese shipping, and the blockade was extended to additional areas. As a result of the previous mining, Japan had been forced to withdraw most of its shipping from the Yellow Sea to the Sea of Japan, and to divert the main traffic to and from the home islands to ports on the Western coasts of Honshu and Kyushu. Their location is shown in Fig. 3. In the third and fourth phases of the campaign, the blockade was accordingly extended to these new targets. The more important harbors of northwestern Honshu and Kyushu were mined first, and when these also had to be abandoned, the minor ports along these coasts were mined as well.

In the last phase, when Japan was already almost prostrate, many of the former targets were no longer worth mining. The shipping situation had become so desperate that even the minimum traffic needed to supply food to the starving population could be maintained only with the greatest difficulty and at the cost of staggering losses in ships sunk or damaged. Repairing damaged ships had become another insuperable problem, since the mines prevented access to all but three of the 22 principal merchant-marine shipyards, and these were overloaded far beyond capacity.⁽³⁾ A final blow was the mining of Korean ports in the closing weeks of the war, which cut off one of the few remaining sources of supply to Japan.

The results of the mining campaign will be discussed in Sec. V. They were succinctly summed up in the words of a British naval historian:

The blockade had, in fact, been far more successful than we realized at the time. Though the submarines had been the first and main instrument for its enforcement, it was the air-laid mines which finally strangled Japan.*

* Reference 14, Vol. III, Part II, p. 371.

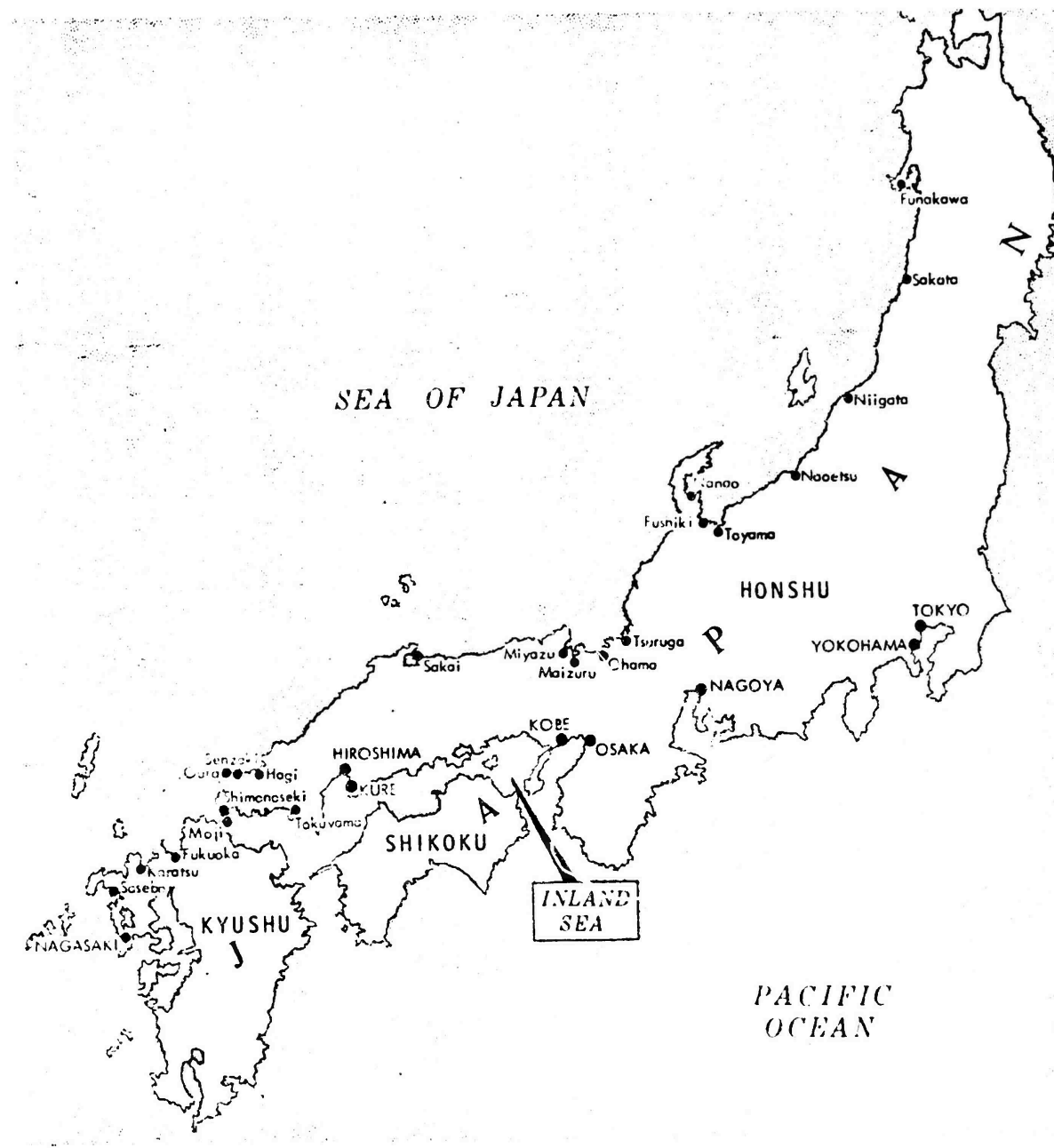


Fig. 3 — Location of northwest Honshu and Kyushu ports selected for mining blockade

The progression to different targets was not the only way in which the pattern of operations changed during the course of the mining campaign. Another major change occurred in the size and frequency of the mining missions.

The full-wing missions employing close to 100 aircraft that ushered in the first and second phases of the mining campaign may have been a carry-over from the pattern of operations established by General LeMay in the CBI when he headed the XX Bomber Command. It was probably necessity more than choice that caused the large missions from the Marianas to be interspersed with much smaller missions during April, when the 313th Wing was busy with other tasks. But it taught the mining planners in the XXI Bomber Command a valuable lesson when they found that the effectiveness of their mining was not proportionate to the scale of effort involved. They reported their conclusion as follows:

A study of the results obtained with full wing and with small mining missions indicated that the length of closure of a port obtained with larger efforts was not increased in proportion to the effort at any specific port. Therefore, it was concluded that in order to obtain closure of a particular port or channel, frequent re-mining was much to be preferred over large scale efforts carried out once or twice a month. Mining every other night using a single group was authorized.*

The new pattern of operations that prevailed during the rest of the mining campaign is shown in Fig. 4. It had the additional advantage that most of the mining was henceforth done by a single, dedicated bombardment group (505th) which became expert in its task.

This is not to suggest that the large full-wing missions were wasted effort. At the beginning of an extended mining campaign it may be desirable to employ a sufficiently large force to be able to lay a minefield that spreads over a wide area or that establishes a dense concentration of mines in one particular area. But during the course of a prolonged campaign it is often more effective to drop fewer mines more frequently. It took the Japanese almost as much time and effort

* Reference 2, p. 10.

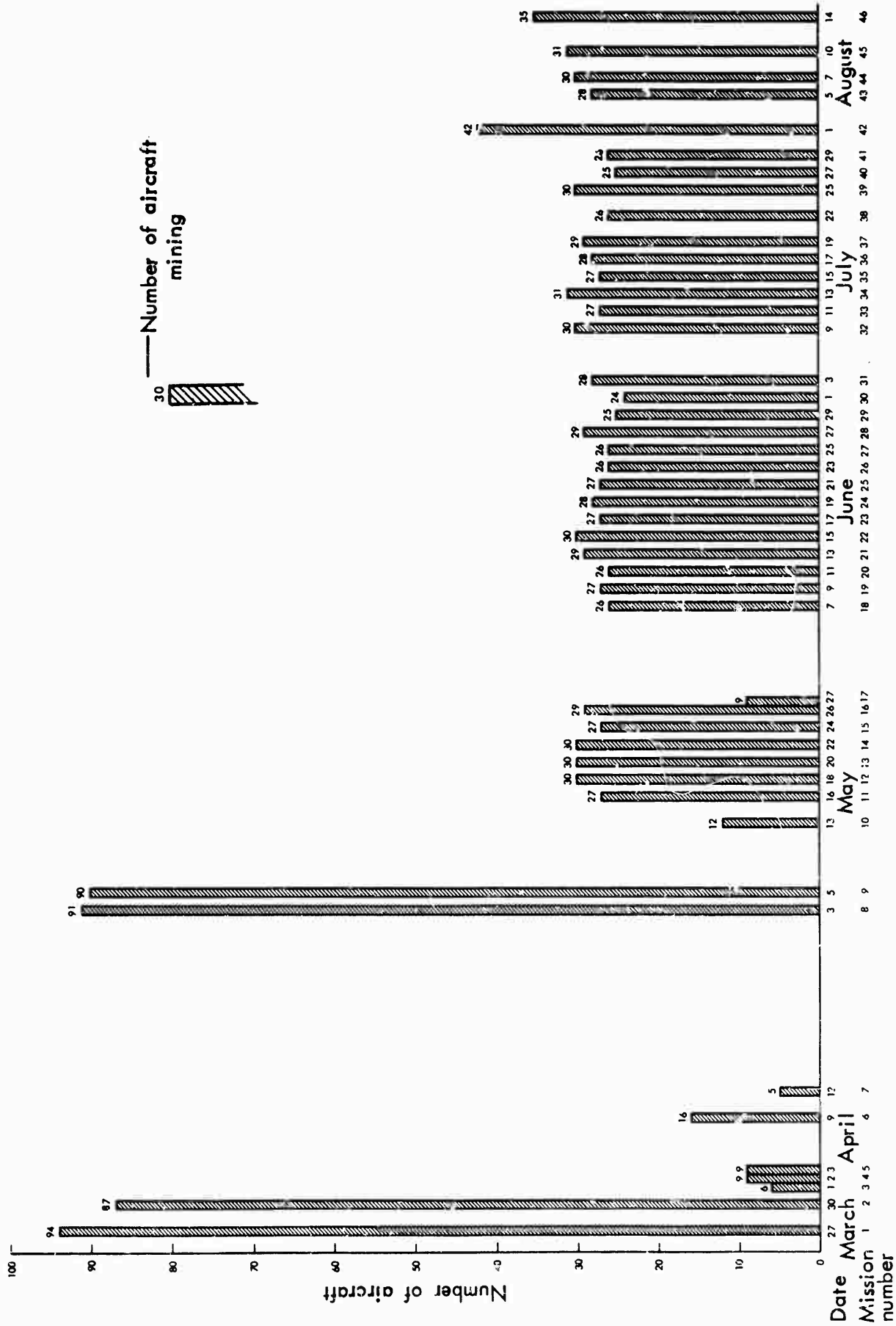


Fig. 4 — Twentieth Air Force mining sortie effort (Source: Ref. 2)

to sweep a channel when a few mines had been laid as it did when there were large numbers. Sometimes even the suspicion that mines had been dropped forced them to undertake the laborious sweeping job before safe passage could be assured.⁽³⁾

The more frequent mining by a single group required the mined areas to be constantly reswept, which closed them to shipping for a longer period and imposed a greater burden on the inadequate Japanese minesweeping force.

But the new pattern of operations also had one disadvantage. The regularity of flying sorties every second night enabled the Japanese mine spotters to anticipate when mines would be laid. This was an important assist to the enemy, who used every possible means--human watchers, radar, and interceptor planes--to detect where mines were being dropped so as to aid the sweeping effort. In some cases, when the spotters were distracted or driven into shelters by a simultaneous bombing raid, it was more difficult to find the right areas to sweep and the sweeping had to cover a larger area.

MINE DELIVERY TACTICS

The operational details worked out by the mining planners in the 313th Wing and the XXI Bomber Command are now mainly of historical interest. With different aircraft, more sophisticated avionics, and new types of mines, future mining campaigns would employ other delivery tactics than those used in the B-29 campaign from the Marianas. Since this account is primarily concerned with lessons that could be applied in the future, only brief mention will be made here of the tactics employed in the Marianas campaign. More information on this subject can be found in some of the histories cited in the bibliography, and especially in the Phase Analysis by the XXI Bomber Command⁽²⁾ from which this short summary has been drawn.

A few statistics will convey the magnitude of the effort.

The average length of a mining sortie from the 313th Wing bases on Tinian to Japan and back was close to 2900 n mi. At this range, the B-29s normally carried a payload of 12,000 to 13,000 lb of mines, usually a mixture of 1000- and 2000-lb mines. The mixture varied, depending on the types of mines available.

The distribution of the mining effort among the different target complexes during the five phases of the campaign is shown in Table 5.

Table 5
DISTRIBUTION OF MINING EFFORT

Phase	Objective	Aircraft Airborne	Aircraft Lost	Mines Laid in Target Area
First	Support Okinawa invasion	246	5	2,030
Second	Blockade industrial centers	195	0	1,422
Third	Blockade northwest Honshu and Kyushu	209	3	1,313
Fourth	Intensify Honshu, Kyushu blockade	404	1	3,542
Fifth	Total blockade	474	6	3,746 ^a
Total		1,528	15	12,053

SOURCE: Reference 2.

^aDuring the last phase an additional $4\frac{1}{2}$ million psychological-warfare leaflets were dropped by the minelaying planes.

By way of comment on these bare statistics, a point should be mentioned that might be of concern to future planners. A major limitation on the size of the mining effort from the Marianas was that there simply were not enough mines available.

In the last few months of the war with Japan the Twenty-first Bomber Command was able and willing to devote a still larger portion of its effort to mine laying but sufficient mine stocks were not available.*

One of the reasons given in the mining report of the United States Strategic Bombing Survey is that conflicting logistic requirements (presumably including preparations for the invasion of Japan) made it

Reference 3, p. 18.

impossible to obtain the necessary priorities for the production and shipment of mines. The decision to launch a massive mining campaign was made too late to change these priorities.

A contributing factor mentioned by the Survey was the tendency to underestimate the number of mines required. There was not sufficient intelligence on Japanese minesweeping capabilities. Neither was there enough recognition, or even knowledge, of the fact that many mines were dropped off the target area or on land, and that even if properly aimed they often exploded prematurely. Several of the Japanese officers and experts interrogated by the Bombing Survey mentioned that they had been puzzled by the premature explosions.⁽³⁾

The trouble was not only that there were not enough mines available but that they were not of the right type. During the entire first phase of the campaign, the old-style magnetic and acoustic mines had to be used, although both had been compromised and therefore could be swept more easily. For the second phase enough magnetic mines with the new "unsweepable" pressure mechanism had arrived, so that half of the mines dropped during this phase were of the new type. By the time of the third phase, the low-frequency acoustic mine, also considered unsweepable, had become available. But there were never enough of the new mines up to the end of the campaign; even during the last phase, more than half of the mines used were still of the old types.^(2,3)

Another complication was that the mining planners on Tinian rarely knew in advance the size or composition of the next shipment of mines they would receive. They therefore had to do their mission planning before they knew what kinds of mines they would be carrying, and hence they usually had to modify these plans after the shipment arrived.

To return to the operational details of the campaign, a brief mention of the mine delivery techniques may be useful. The mining planners had decided to adapt the tactics used in the incendiary raids on Japan instead of those that had been the standard practice when the B-29s were engaged in daylight precision bombing and had flown in tight formations. The minelaying was to be done at night, by aircraft flying singly and spaced far enough apart to present a more difficult target to the enemy's antiaircraft defenses. The B-29s therefore were able to

carry far heavier payloads than if they had had to fly in formation. Dispensing with formations also saved wear and tear on the engines and reduced pilot fatigue.

The radar bombing technique that had been developed for the incendiary raids served well enough for mine delivery but had to be modified to allow for the wind drift of the parachute-retarded mine-fall. In order to minimize drift, a relatively low altitude was indicated. At the same time, the planes had to fly high enough to reduce losses from enemy flak. In night operations this would be their only threat, since the Japanese night-fighter capability was known to be negligible. But prior to the campaign there was no information on antiaircraft defenses in the target areas, for no photoreconnaissance missions had been flown until after the mining began. The planners therefore decided to do the mining at the same altitudes of five to six thousand feet that the XXI Bomber Command had adopted for its successful low-level incendiary bombing missions against Japanese urban areas. It turned out to be the right choice. Aircraft losses during the mining campaign were much lower than had been expected.

Computations of the mine release point involved a somewhat complicated procedure because of the different ballistics of the parachute-retarded mines; their trail and crosstrail were so great as to be beyond the limits of the bombsight. Inasmuch as the desired impact point and the spot immediately beneath the release point were both on water and could not be identified by radar, an offset aiming point on land had to be used. The resulting delivery accuracy, though not very good, was judged acceptable for mining purposes. Delivery errors of one to two miles were normal but could be compensated for by the simple device of sowing more mines.

THE BATTLE OF WITS BETWEEN MINELAYERS AND MINESWEEPERS

It is no news to any mining expert that a mining campaign is a continuous game of measures and countermeasures and counter-counter-measures. But this basic fact is not always taken into account in the advance planning of future operations, which often involved officers with little or no experience in mining.

Mines are of limited use if they are easy to clear. They must be so constructed, and so placed, that clearing them will strain the enemy's sweeping facilities and will be so time-consuming as to tie up shipping for prolonged periods. It is not always recognized that mines may contribute as much, or more, by immobilizing ships as by sinking them.*

One way of making the mines more difficult to clear, apart from the ingenuity that goes into the original construction of the mine, is to make frequent modifications in it through changes in the arming delays, ship counters, and timing sequences within the firing mechanism. During the B-29 campaign this was done by the Naval Mine Modification Unit, which was moved to Tinian in April 1945 so as to be collocated with the mine delivery force of the 313th Wing. Both organizations were well aware of the importance of this task; it is estimated that 80 percent of the mines dropped by the B-29s in Japan's Inner Zone were modified in the theater.

Since one purpose--but not the only purpose--of the modifications was to hinder the enemy's countermeasures by forcing him to develop new sweeping gear or different clearing techniques, they required an intimate knowledge of minesweeping, in addition to intelligence of the enemy's sweeping facilities and methods.

Experience during the war has emphasized the need of considering mine laying and mine sweeping as closely related operations classed generally as mine warfare. Personnel engaged in either branch had to be familiar with the other in order to perform their job properly.... Since extensive development of the ground [bottom] mine with its influence firing mechanism has made modern mine laying and mine sweeping more interdependent as ever, it is important that in the future the two operations be considered to be inseparable elements of mine warfare.**

But mine modifications were intended to serve another purpose as well, which was to increase the probability of sinking enemy ships,

* More on this subject will be found in Sec. V.

** Reference 3, pp. 29-30.

and especially the larger vessels. The two purposes must have been occasionally in conflict, if only for the obvious reason that one way of interfering with the enemy's countermeasures would have been to modify the mine setting so as to sink the small shallow-draft mine-sweeping vessels. Undoubtedly there were other ways in which modifications made for one purpose defeated the other, for mines lose effectiveness if they are not tailored for a specific purpose.*

It is not clear whether the planners of the B-29 campaign made a sharp enough distinction between the two different purposes that the mine modifications were intended to serve, or which of the two was predominant in their minds. Though the evidence is inconclusive, there is reason to suspect that the temptation to show demonstrable results, as represented by ship sinkings, may have outweighed the desire to counteract the enemy's minesweeping efforts, which could only produce intangible results that are not measurable.

It was fortunate for our side that the Japanese, unlike the Germans, were poorly prepared for effective mine-clearing operations. During the two years that had preceded the campaign from the Marianas, they had allowed local authorities in the Outer Zone to improvise defense measures against the aerial mining done by the Allies. In the homeland itself, they had done little centralized planning for the major effort that was to be required when the massive campaign against the Inner Zone was launched.⁽³⁾ Cooperation was poor between their military authorities and the scientists whom they needed to deal with the increasingly sophisticated mines used in the campaign. They did not have anywhere near the necessary amount, or the right kind, of sweeping equipment, and what they had was not always where it was most needed.

Nevertheless, it is estimated that by the end of the war the Japanese had, in the Inner Zone alone, spent 35,715,340 yen and employed more than 20,000 officers and men in connection with that [mine countermeasures] effort. By the end of the

* The British aptly called their version of the Mine Modification Unit the Tailored Mine Station.

war, the Japanese had developed fairly effective sweeps for all United States mines except one acoustic mine and the pressur mine.*

That the Japanese succeeded even to that extent was not due solely to their own efforts, but because we made the job easier for them. As already noted, failure of the United States to have made timely preparations for a major mining campaign resulted in an inadequate supply of mines, and especially of the new types. Japanese naval experts told their interrogators after the war that it had taken them as long as one or two months to find ways of dealing with a new type of mine or with modifications of the mine mechanism. Mine clearing was especially difficult for them when a mixture of magnetic-acoustic and magnetic-pressure mines had been laid.⁽³⁾ But the minelaying force had to use whatever mines were at hand. They could not wait for the right types of mines or the right combinations of mines. When the new types of mines finally began to arrive, there were never enough of them and they often had had to be rushed to the theater without adequate proof-testing, with the result that many exploded prematurely. Another, more important consequence of these irregular shipments was that the necessary mine modifications, which had to be made in the theater, could not always be made in time for the next scheduled mission.

These difficulties were aggravated by the pattern of operations adopted after the middle of May, when mining missions were flown in regular intervals every second night. Apart from the fact that the regularity of this pattern warned the Japanese mine spotters when to be alert, it also foreclosed the opportunity to wait for the right kinds of mines to arrive and to complete the necessary mine modifications. There undoubtedly were sound operational reasons why the commanding general had ordered this pattern of operations. But there may have been other factors as well, including the normal human tendency to judge success by the size and intensity of the effort.

One of the Japanese mining officers interviewed by the United States Strategic Bombing Survey was Captain Kyuzo Tamura, IJN, who pointed out

* Reference 3, pp. 27-28.

several other aspects of the mining campaign that made it less effective than it might have been. For instance:

America, almost exclusively, used the ground mine. It is believed that better results would have been obtained if moored mines and small mines which would have been effective against small vessels had also been used to increase losses in mine sweeping vessels and to make large vessels uneasy even when in deep water. American mine warfare apparently overlooked this point. In depths of water over 50 meters [150 feet] it was unnecessary for us to make sweeps and our ships and mine sweeping vessels were able to pass through such depths without anxiety. It is believed that it should not be possible to do this.*

The use of moored mines, assuming that they had been available for aerial delivery, would have permitted the mining campaign to be extended so as to interdict deep-water shipping, as well as the traffic in the shallower waters close to shore. This might have proved an even more important factor in the mining of the Outer Zone than during the B-29 campaign, when most Japanese shipping had already been driven off the high seas. A capability for deep-sea mining through the use of air-delivered moored mines could also be required in future conflicts if there is a need for mining larger areas away from strongly defended harbors and coast lines.**

Another deficiency that assisted the Japanese in their counter-measures effort was that the mines lacked a self-destruct mechanism. Since they were frequently dropped on land and could be retrieved intact, their construction was compromised. Fortunately the Japanese were not able to take full advantage of this, since they too had been guilty of having underrated the importance of mining and had neglected to make timely preparations for their defense against this threat. By the time they came to appreciate the gravity of the mine threat, it was too late to develop the necessary technical skills, and their war-torn country no longer had the resources needed to build enough mine-sweepers and sweeping equipment.

* Reference 3, p. 37.

** The subject of moored mines for future use is discussed by J. W. Higgins and H. A. DeWeerd, *op. cit.*, p. v, footnote.

The role played by Japanese mine spotters was another factor that seems to have been overlooked in the planning of the B-29 campaign. This was of considerable benefit to the defenders, as was again pointed out by Captain Tamura in his interrogation by the United States Strategic Bombing Survey:

If you had been able to disguise the places and times of the dropping of mines by your planes our countermeasures research would have been delayed and losses would consequently have been greater. Even though we had a difficult time in working up countermeasures against mines, it would have been much more difficult if we hadn't been able to watch planes drop mines and recover them immediately. The important thing is not to let the Japanese know you were dropping mines. Another weak thing was so many dropping on land, making recovery easy.*

In the same interview, Captain Tamura also mentioned that his mine spotters were further assisted by the practice of dropping the mines in the same narrow patterns, instead of spreading them at random over wider areas.

The mine laying planes always laid their mines in a simple row which made it easy for our lookout activities to analyze the plan and determine where the mines were and adopt effective countermeasures. It is necessary to vary the plan of laying occasionally.**

One reason why the mines were dropped in this manner is suggested by the authors of the XXI Bomber Command report.⁽²⁾ They had hoped that after a wide and heavy minefield had been laid in the initial large missions, the enemy would be forced to sweep a channel through it which could be closed through subsequent remining along a narrow path. Though this would involve a continuous clearing effort by the defenders, the job would be easier for them if they had only a straight row to sweep. If the purpose was to defeat the enemy's countermeasures, it would seem that this was not the best way to go about it.

* Reference 3, p. 41.

** Reference 3, p. 37.

But it may not have been the only purpose. The planners may have hoped that more tonnage would be destroyed if the mines were laid in the channel to which enemy shipping would be confined. It would not have been the only instance when the desire to increase the toll of enemy shipping tonnage sunk or damaged influenced the planning of the mining campaign.

It is equally possible that these, like other tactics, were chosen for purely operational reasons. That the mines dropped from a single aircraft fell in a more or less straight row obviously could not be helped, although the dispersion caused by wind acting on the parachutes may have broadened the mine path somewhat. But in order to minimize the possibility of collision, it was also decided that all the aircraft that were within a given area at the same time had to fly in the same general direction. Since it would be operationally easier for all the aircraft to use the same IP, the only way of widening the mine pattern was therefore for the different aircraft to use a slightly different axis of attack, by fanning out after passing the IP (about 30 miles from the target area). For one reason or another, this last maneuver may not always have been followed as closely as was planned, which might account for so many of the mines being dropped in a single row.

One offsetting feature, though the minefield planners cannot claim credit for it, was that a more random pattern was achieved, whether they desired it or not, simply because the mine delivery technique used did not permit great accuracy. With CEPs on the order of one to two miles, and the further dispersion caused by the unpredictable ballistics of parachute mines, it would not have been possible to put the mines exactly where they were wanted.

V. AIMS AND RESULTS

The Phase Analysis of the XXI Bomber Command describes succinctly what the campaign planners had hoped to accomplish:

The mining mission was to complete the destruction of the Japanese shipborne lines of communication. The three principal objectives were:

1. To prevent the importation of raw materials and food into Japan.
2. To prevent the supply and deployment of her military forces.
3. To disrupt her internal marine transportation within the Inland Sea.

It was believed that the mining, if carried out in force, would terminate practically all imports into Japan; first of raw materials, finally of food. As a result, enemy industry would be starved of materials and eventually cease production, and the enemy population would be reduced to starvation. The effect of starvation would combine with the incendiary raids to reduce the civilian will to wage war. Therefore, the operation was called STARVATION.*

How much the civilian will to wage war was actually reduced, and what role this may have played in Japan's collapse, will remain a matter of debate and is beyond the scope of this study.** There is no question, however, that the other objectives listed in the Phase Analysis had indeed been achieved. Japan's material condition at the

* Reference 2, p. 3.

** Most historians of the strategic air campaigns against Germany and Japan conclude that the effect of the attacks on civilian morale was less than the air strategists had expected. In an authoritarian state, it is the behavior of the population that matters, not its morale, and behavior can be controlled. In Japan, moreover, the U.S. Strategic Bombing Survey noted that while there had been some drop in civilian morale at the end of the war, it did not seem to have affected "the Yamato spirit of the Japanese people, their willingness to make every personal sacrifice, including life itself, for the Emperor of Japan" and that, until the end, "national traditions of obedience and conformity, reinforced by the police organization, remained effective in controlling the behavior of the population" (Ref. 5, p. 21).

close of the war had become desperate. Her economy had been strangled through the denial of essential resources; maritime traffic to and from the outlying possessions, and between the home islands, had dropped to a trickle; food supplies had fallen below the subsistence level.

COLLAPSE OF THE EMPIRE

The collapse of the Empire cannot be attributed to any single cause. It was the end result of Allied pressure on many different fronts, combined with basic weaknesses inherent in the Japanese situation. What concerns us here is the contribution made by the mining campaign during the closing months of the war in reducing an already defeated enemy to a state of complete hopelessness.

The paralysis of Japan's maritime traffic was an important factor in her eventual collapse. Much of her merchant marine had been sunk before the B-29 mining campaign began. Japan had entered the war with approximately 6 million tons of merchant ships of over 500 gross tons, and had added another 4.1 million tons during the war through new construction, capture, and requisitioning.⁽⁵⁾ By 27 March 1945, on the eve of the mining campaign, only an estimated 1.8 million tons^{*} were still afloat.⁽²⁾ Allied submarines had accounted for well over half of the losses; attacks by carrier- and land-based aircraft, plus the mines dropped prior to the B-29 campaign, had done the rest.

Japan's shipping capacity, already totally inadequate as a result of these previous losses, suffered a further sharp decline during the last five months of the war. The available sources do not agree on the tonnage of ships sunk or damaged by mines during the B-29 campaign; it was at least $\frac{3}{4}$ million tons and may have been as much as $1\frac{1}{4}$ million

^{*} This rough estimate only includes steel ships of over 1000 gross tons and is therefore not strictly comparable with the earlier figure. Such discrepancies between different sources, and the unreliability of wartime statistics in general, must be kept in mind whenever figures are cited in this account. They are at best approximations and are often highly speculative because many of the basic Japanese source data are lost or burned. Quantitative evidence is used here to convey a general idea of magnitudes but should not be accepted as precise or accurate.

tons or possibly more, since the Japanese often attributed ship losses to torpedoes when they were not sure of the cause. Whatever the correct figure may be, it tells only part of the story. The mining had another, perhaps more critical effect upon Japan's maritime traffic by immobilizing ships that were still seaworthy. After a minefield had been laid, the Japanese normally suspended shipping and allowed the vessels to remain in port while channels were being swept. The ships might see service again, but the ship-days of potential traffic lost while they were laid up in port were lost forever.

The respective roles that these two mutually reinforcing effects--ship sinkings and ship blockade--played in the success of the mining campaign will be discussed later on. Our present concern is with the combined results, as reflected in Japan's difficulty to maintain her vital sea lines of communication. In the closing months of the war they had become the lifeline on which the Empire depended, no longer so much to support what remained of its dwindling war effort as to sustain its very existence.

An indication of how precarious that lifeline had become can be seen in the following two graphs. The drastic reduction in ship passages through the Shimonoseki Strait (Fig. 5) is especially significant, since this had been the main traffic route for shipments to the home islands. By July 1945, passage through the strait had fallen to less than one-tenth of what it had been in March; it became a mere trickle in August. Another indicator of the crippling effects of the blockade is the decline in ship tonnage entering the major Japanese ports (Fig. 6). Despite efforts to reroute traffic around the mined areas, the mining campaign caused shipments to the industrial ports to drop from over 800,000 tons in March 1945 to about 250,000 tons in July.

The effects of this traffic stagnation upon the Japanese economy are illustrated by the growing shortage of key commodities. Imports of the principal commodities listed in Table 6 already had been curtailed long before the mining campaign began, having dropped by half between 1941 and 1944. In the first six months of 1945 they suffered another sharp decline to approximately one quarter of the prewar rate. It can be assumed that this reduction in imports that were essential

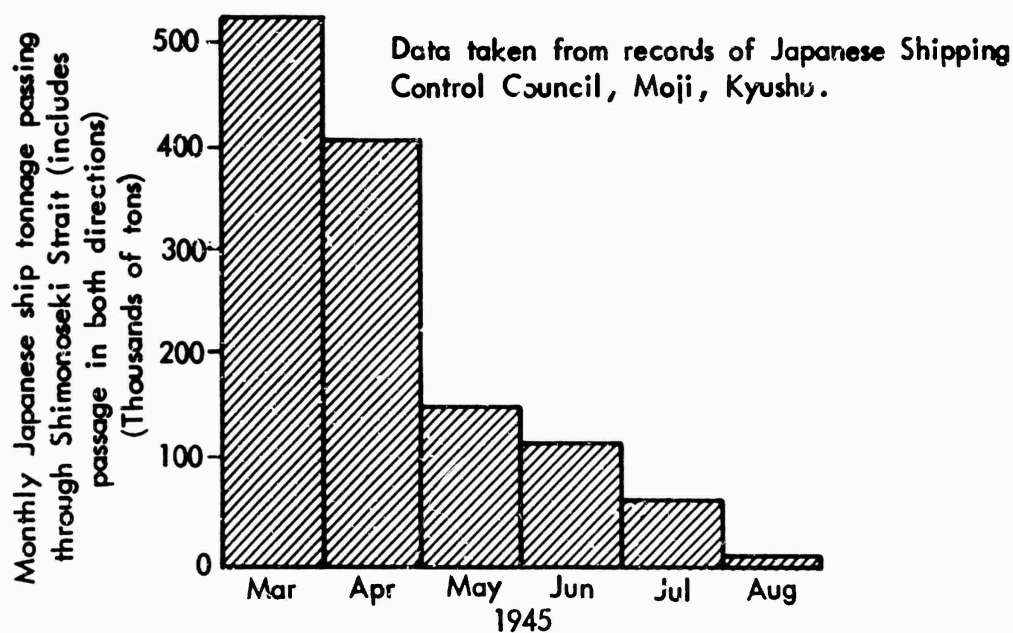


Fig. 5 — Effect of B-29 minelaying on ship passage through Shimonoseki Strait (Source: Ref. 3)

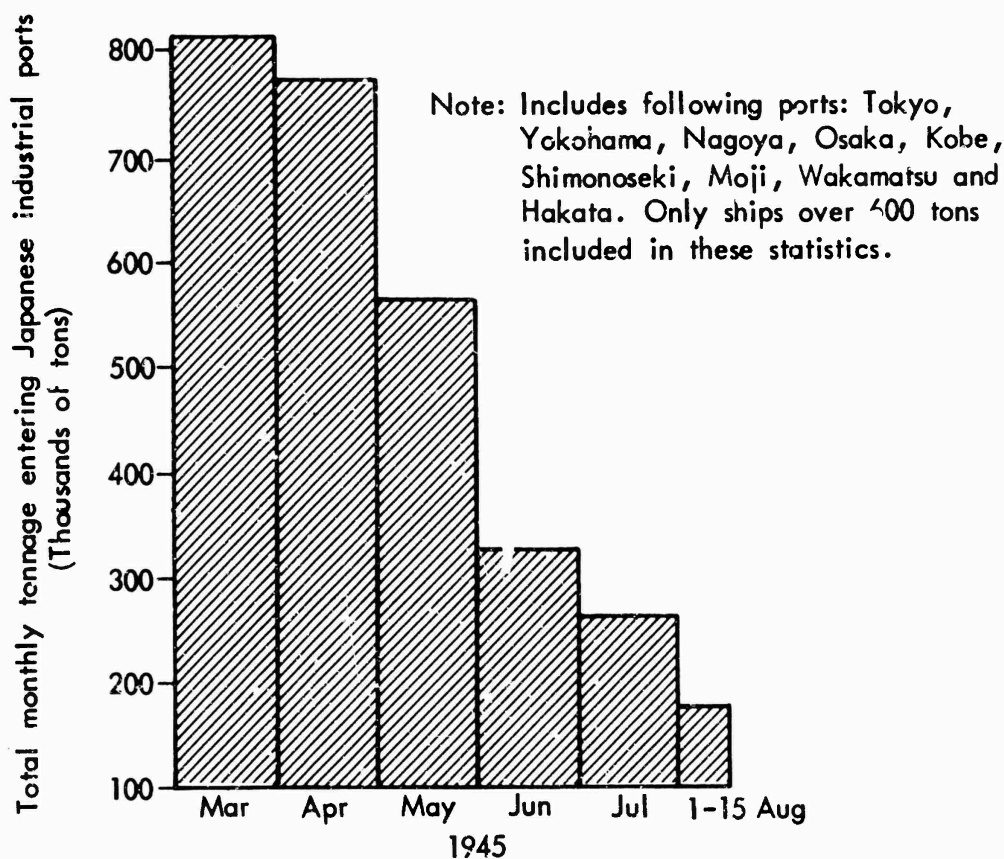


Fig. 6 — Total tonnage entering Japanese industrial ports during period of B-29 minelaying (Source: Ref. 3)

Table 6
JAPANESE IMPORTS OF SELECTED KEY COMMODITIES
(In metric tons)

Commodity	1940	1941	1942	1943	1944	1945 ^a
Coal	7,011,000	6,459,000	6,388,000	5,181,000	2,635,000	548,000
Iron ore	6,073,000	6,309,000	4,700,000	4,298,000	2,153,000	341,000
Bauxite	275,000	150,000	305,000	909,000	376,000	15,500
Iron and steel	621,000	921,000	993,000	997,000	1,097,000	170,000
Scrap iron	2,104,000	246,000	50,000	43,000	21,000	12,000
Lead	100,000	86,530	10,990	24,500	16,810	4,000
Tin	10,500	5,500	3,800	26,800	23,500	3,500
Zinc	23,500	7,900	8,500	10,100	6,100	2,500
Phosphorite and phosphate	710,400	396,500	342,100	236,700	89,600	23,000
Dolomite and magnesite	409,600	506,300	468,700	437,500	287,100	65,900
Salt	1,728,300	1,438,900	1,499,800	1,425,100	989,700	386,900
Soybean cake	333,900	337,700	499,500	304,500	384,700	163,400
Soybeans	648,500	572,400	698,800	590,600	728,800	606,900
Rice and paddy	1,694,000	2,232,700	2,629,200	1,135,800	783,200	151,200
Other grains and flours	269,500	267,400	823,300	750,100	506,600	231,400
Raw rubber	27,500	67,600	31,400	42,100	31,500	17,900
Total	22,039,600	20,004,430	19,402,090	16,411,880	10,129,610	2,743,000

SOURCE: Reference 4, p. 100.

^aFirst six months of 1945 only.

to the Japanese economy was made only as a matter of last resort, after all less essential imports already had been cut to the bone.

A more dramatic indication of Japan's plight is provided by the changes in priority she was forced to make even within the group of essential commodities. Shipping space had become so scarce that in order to conserve space for desperately needed food shipments, imports of the other key items required by the economy had to be sacrificed. The figures in Table 7 speak for themselves. As the total cargo space allocated for the shipment of vital commodities dropped from 1,178,600 tons in April to 815,760 tons in August, the portion of space allowed for such essentials as coal, iron and steel, and nonferrous metals was reduced even more than the decrease in available shipping capacity so as to step up the imports of such absolute necessities as salt and cereals.

Despite all efforts, however, Japan was unable to maintain an adequate food supply for her civilian population. Her food consumption had always been low by Western standards; the prewar daily average had been around 2000 calories, as against an average of about 3400 calories for the United States. The Japanese food ration was further reduced during the war until, by the summer of 1945, consumption had fallen to an average of 1680 calories per person.*

But the average per capita intake does not tell the whole story. Since coal miners and other essential industrial workers received higher food rations, a large portion of the populace must have been subsisting on less than the low average of 1680 calories, which meant that they were living at or near the starvation level. Nor does the total caloric intake reflect the lack of important nutrients in the diet, which accounted for the low disease resistance and the increase in deficiency diseases among the population.

The food shortage, though primarily due to the disruption of Japan's shipborne traffic, was aggravated by other Allied actions. The bombing attacks on the home islands were creating havoc in the major cities, disrupting communications and causing distribution difficulties.

*Reference 5, pp. 20-21.

Table 7
ALLOCATION OF SHIPPING SPACE (TONS OF CARGO CAPACITY) TO SELECTED KEY COMMODITIES
IN THE LAST FIVE MONTHS OF 1945

Commodity	April		May		June		July		August ^a	
	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%
Coal	605,500	51.4	467,900	42.3	268,398	31.1	277,728	35.8	280,650	34.4
Iron and steel	75,200	6.4	69,800	6.3	27,744	3.2	17,771	2.3	15,410	1.9
Nonferrous metals	73,400	6.2	79,900	7.2	21,101	2.4	32,326	4.2	46,150	5.6
Salt	74,000	6.3	90,200	8.1	99,684	11.6	112,911	14.6	149,950	18.4
Cereals	194,900	16.5	329,300	29.7	345,786	40.1	294,452	38.0	267,550	32.8
Miscellaneous	155,600	13.2	70,500	6.4	100,423	11.6	39,374	5.1	56,050	6.9
Total	1,178,600	100.0	1,107,600	100.0	863,136	100.0	774,562	100.0	815,760	100.0

SOURCE: Reference 4, p. 93.

^a Allotment of shipping space, rather than cargo actually shipped.

In some of the attacks precious reserves of rice and other food stocks were destroyed.

There is no doubt that the mining campaign accomplished all, and more, that had been hoped for it. If it did not "prevent" the importation of raw materials and food into Japan, it reduced it below the critical point. The Japanese economy was denied essential raw materials. The food situation had become so desperate that in a few more weeks or months the population might have faced actual, widespread starvation.

So far as the other two objectives of the campaign are concerned, these, too, were successfully achieved, although the results cannot be documented as easily as the reduction in imports.

We know that the lack of shipping capacity, combined with Allied domination of the high seas, made it virtually impossible for the Empire to supply or reinforce her large armies, which were still making a last-ditch fight in Burma, Okinawa, and elsewhere. On most of the Pacific islands bypassed by the Allies, the Japanese occupation forces had to subsist on what they could obtain locally; they had been left to wither on the vine, since they were cut off from contact with the homeland.

As for the disruption of internal marine transportation within the Inland Sea--the third of the three principal objectives of the campaign--aerial reconnaissance showed that by the end of the war such traffic had practically come to a standstill. What quantitative evidence we have to support this observation has already been presented in this section, showing the effects of the blockade.

If, as the record shows, the economic strangulation of Japan was a major factor in her collapse, it was primarily due to the long Allied campaign against her maritime lifelines. The B-29 mining campaign, though it occurred late in the antishipping offensive, played a vital part in it. It dealt the *coup de grace* to what was left of the Japanese merchant fleet.

The United States Strategic Bombing Survey concluded in its Summary Report⁽⁵⁾ that the economic paralysis of the Empire could have been extended and accelerated if certain changes had been made in Allied strategy, including "an earlier commencement of the aerial

mining program." The reader will recall a discussion of this point in Sec. III, dealing with the genesis of the B-29 mining campaign. A better appreciation of the potential of mining as an instrument of aerial warfare might have led to earlier employment of this weapon on a massive scale, in preference to the efforts devoted to preparing for the controversial invasion of the Japanese home islands. For we now know, with the benefit of hindsight, that the collapse of her economy alone made it impossible for Japan to hold out much longer. The atomic bombs merely hastened the end by a few weeks or months. As the Survey stated unequivocally, the surrender was inevitable even without the atomic bombs and without the planned invasion.

Based on a detailed investigation of all the facts, and supported by the testimony of the surviving Japanese leaders involved, it is the Survey's opinion that certainly prior to 31 December 1945, and in all probability prior to 1 November 1945, Japan would have surrendered even if the atomic bombs had not been dropped, even if Russia had not entered the war, and even if no invasion had been planned or contemplated.*

SHIP SINKINGS VERSUS BLOCKADE

The ultimate objective of the B-29 mining campaign was clearly understood and agreed upon by the planners. In the words of the XXI Bomber Command report, it was to complete the destruction of the Japanese shipborne lines of communication. There seem to have been differences of opinion, however, on the best way of achieving this.

There was some disagreement on the goal of the mining attack. Blockade was the stated objective, but many felt the goal was sinkings. (With a mine field of less than 100% effectiveness, or threat, ship sinkings and blockade are not only incompatible, but almost mutually exclusive goals for the mine field planner. For, if some ships are sunk, others must necessarily be getting through, thus the blockade is less than perfect. Conversely, if blockade is in fact achieved, no ships are

* Reference 5, p. 26.

sunk.) Although the effectiveness of Operation Starvation is universally demonstrated by ship loss statistics, it is clear that blockade was the goal. The denial to Japan of the food and materials of war from its overseas holdings was the main and constant objective of Operation Starvation.*

The author of this quotation, a naval officer with considerable mining experience, raises an important issue. If ship sinkings and blockade are indeed mutually exclusive goals, there is no evidence that the planners of the B-29 campaign made a deliberate choice between the two. Their preoccupation with ship sinkings, in the conduct as well as in the reporting of the campaign, could have been simply because ship losses are regarded as a more convincing measure of success.

The issue is central to any consideration of past or future mining operations. Maritime traffic is reduced regardless of whether the ships are actually sunk or merely immobilized in port through the threat of sinkings. In most cases, the two effects need to be combined, for it is rarely possible to impose a perfect blockade without demonstrating its effectiveness through actual ship losses. Nevertheless, greater emphasis on one or the other in the planning and execution of a mining campaign is likely to yield different results. The question is which is the more effective method, and what does its effectiveness depend on.

The recent mining of Haiphong Harbor in North Vietnam was one of the few instances in which a watertight blockade was established without any ships being sunk. This could have been because the North Vietnamese were convinced in advance, without waiting to have it demonstrated through ship losses, that the minefield was 100 percent effective. A more likely explanation is that their Russian and Chinese suppliers shied away from the repercussions that might have followed from the sinking of their ships, and that the North Vietnamese, feeling that

* Reference 9, p. 97. If blockade was only the "stated objective," while others felt that the goal was ship sinkings, it could not have been "clear that blockade was the goal." What the author must mean is what he says in the last sentence, that the only clear goal was the denial of imports.

they could get along without the use of Haiphong, respected their sponsors' wishes.

Whatever the reason may have been, it was North Vietnam's decision to submit to the blockade without testing it that made it successful even though no ships were sunk. In a different situation an opponent may try to break the blockade even if he has reason to believe that the minefield is highly effective. He cannot know in advance how effective it will prove, and neither can the minefield planners. More important, and regardless of how he assesses the threat, circumstances may force him to accept losses in order for some ships to get through. Sacrificing ships is an expensive way of clearing mines, but a desperate opponent may have no other alternative.

Whether the goal of a mining campaign should include ship sinkings as well as blockade will therefore depend on the opponent's situation and on the manner in which he reacts to the mining.

This was demonstrated during the B-29 campaign. In the beginning, the Japanese reacted by suspending or reducing traffic in the mined areas until channels had been swept. Even where it was only suspected that mines had been laid, shipping was stopped while the minesweepers went to work. During that period, the Japanese policy was to leave it to the ship captain's discretion whether to take his vessel through a suspected minefield or not. The result was reflected in the XXI Bomber Command estimate that in the first phase of the campaign (27 March to 3 May) only 35 ships totaling 100,000 gross tons were sunk, but that traffic through the Shimonoseki Strait had been reduced to 25 percent of normal.*

There are a number of possible explanations why blockade proved more effective than ship sinkings in reducing maritime traffic during the early part of the campaign. For one thing, the mining attack had taken the Japanese by surprise. Their first, instinctive reaction may have been to save what was left of their precious ships without considering the effect upon their essential imports. We know that they

* A more definitive postwar analysis gave an even lower figure of 18 ships totaling 31,000 tons sunk or disabled during this period (Ref. 4, p. 38).

underrated the duration and intensity of the campaign, and they were probably too optimistic in what they expected of their minesweeping capabilities. If they believed, or hoped, that they would soon be able to resume normal shipping, the immobilization of their ships may have appeared to them as a painful but temporary expedient, preferable to losing the ships permanently.

These hopes were disappointed as the pace of the mining campaign was not only maintained but stepped up. When the Japanese realized what the resulting drop in maritime traffic was doing to their already precarious supply situation, they began to take greater risks in braving the minefields. The number of ships sunk or damaged by mines took a sharp upswing in May and remained high through the succeeding months. The figures in Table 8 are the best available estimates compiled by the U.S. Strategic Bombing Survey.

Table 8

JAPANESE MERCHANT SHIPS SUNK OR DAMAGED
BY MINES DURING B-29 CAMPAIGN

Period	Ships Sunk or Damaged	Gross Tons
Apr ^a	18	31,000
May	85	213,000
Jun	83	163,000
Jul	78	198,000
Aug ^b	29	67,000

SOURCE: Reference 4.

^aActually from 28 March to
3 May.

^bFirst two weeks only.

It is evident that only dire necessity could have induced Japan to accept such losses. By a conservative estimate, they had reduced serviceable merchant shipping in the Inner Zone to around 550,000 tons by the end of the war. ⁽⁴⁾ Another estimate, made by the XXI Bomber Command on the basis of aerial reconnaissance, was that merchant shipping

had been reduced to less than 350,000 tons.⁽²⁾ There was additional Japanese shipping still afloat in the Outer Zone, but it was no longer of much use in supplying the blockaded home islands.

Since the Japanese eventually were forced to risk exposure of their ships in order to maintain a minimum of essential traffic, it would seem that the minefield planners were justified in their preoccupation with ship sinkings. But this tendency was apparent even before the campaign began and before it was known how the Japanese would respond to the blockade. One of the key decisions made by the XXI Bomber Command when planning the campaign was "to select for sinking the larger ships of the enemy's fleet."⁽²⁾ The desire to destroy as much enemy ship tonnage as possible runs throughout the official report on the campaign.

In order to correct the defects and weaknesses of the standard M11 and M9 Mod 1 magnetic and A-3 acoustic mechanisms, local modification of these mechanisms was proposed to accomplish two things: First, and most important, to defeat the known enemy sweeps, and, second, to select the largest enemy ships for sinking, so as to obtain maximum damage on a tonnage basis.*

Or again:

More than 60 percent of this [Japanese] shipping was composed of ships with a size of 4000 gross tons or larger. These large ships were the prime targets, and one of the mining problems was to sink ships selectively. One mine could sink or seriously damage one 10,000 ton ship at ten times the profit that would be obtained if the same mine sank or damaged one 1000 ton ship.**

The planners clearly were concerned with ship sinkings not solely as a means of enforcing the blockade but as an end in itself. It was a legitimate goal, to be sure, as legitimate as blockade, at least in the later phases of the campaign. The two are not mutually exclusive,

* Reference 2, p. 6. Emphasis added.

** Reference 2, p. 3. Emphasis added.

as Commander Meacham asserted,* but may have to be pursued side by side, depending on the opponent's reaction to the mining. Whether ship sinkings should be treated at all times as the *preferred* goal, however, as the XXI Bomber Command seems to have done, is a different matter.

Some mining experts believe that blockade should be the preferred objective.

In considering the accomplishments of the mine laying campaign, it should be recognized that ship losses are but incidental to the primary objects of mining which are to delay and disrupt the enemy's shipping, disorganize his maritime supply system, and thereby deprive him of essential military and economic materials. These latter effects cannot be evaluated directly as they are too closely integrated with results from all other forms of attack on transportation and shipping. Sufficient information is available, however, to indicate that mining made a significant contribution towards this end.**

The naval authors of this quotation may have put their finger on the reason why their choice of priorities did not prevail. The results of blockade "cannot be evaluated directly" and their impact is delayed. Ship sinkings, on the other hand, can be observed immediately and reported in concrete numerical terms.

It should not be surprising that "the effectiveness of Operation *Starvation* is universally demonstrated by ship loss statistics."* War-time commanders are expected to show tangible results that are easily understood and can be used to satisfy the hunger for good news. This is why the number of enemy troops killed or captured is so often accepted as the measure of success in ground battles, and why the number and tonnage of enemy ships sunk played a similar role in the mining campaign. If the campaign planners were tempted, or were under pressure, to produce a high "body count" of ship losses it would not have been the first time, nor was it the last, that this familiar syndrome influenced the goal as well as the reporting of military operations.

* See p. 61.

** Reference 3, p. 2. Emphasis added.

This is not meant to disparage the important contribution that ship sinkings made toward the ultimate objective of the campaign. The losses inflicted on Japan's merchant marine by the mining depleted her shipping capacity so severely that on this ground alone maritime traffic would have been cut to a fraction of its former level. But the reduction in traffic was the combined result of several causes, of which the ship losses were only one. Another major cause, possibly more important even than ship sinkings, was the prolonged immobilization of ships when they were held in port while waiting for the mines to be cleared. Some decline in traffic was also due to the B-29 bombing attacks on port facilities and to other difficulties that cannot be solely attributed to the mining campaign but were aggravated by it, such as fuel shortages and the overcrowding of ship repair yards.

One of the crucial questions about the campaign is which of the two primary effects of the mining--ship sinkings and ship immobilization--contributed more to the decline in Japanese shipping. Unfortunately, the two effects are impossible to separate. There are no reliable statistics even on the total reduction in ship-days of traffic from all causes, let alone on the portion attributable to each of the two major causes. We have some evidence, however, even though it is fragmentary, to indicate that blockade must have accounted for a large portion of the overall decline in traffic.

It will be recalled that the first phase of the mining campaign began with two full-wing missions on 27 and 30 March, and that the second phase essentially consisted of two equally large missions on 3 and 5 May, with a few smaller missions being interspersed in April.* The bulk of this effort was concentrated on Shimonoseki Strait and on ports on the Inland Sea. The XXI Bomber Command estimated on the basis of aerial reconnaissance that the result of the mining had been to reduce ship passage through the strait from around 40 ships (70,000 tons) per day in March to as little as two to four ships per day (7000 tons) by the end of May.⁽²⁾ Although this estimate may have been too optimistic, other sources agree that in May Shimonoseki was completely closed to traffic for four days and partly closed on other days, and

* See "Pattern of Operations" in Sec. IV.

that on a daily average about 80 ships were tied up by the blockade.^(1,4) Total traffic through the strait during the month of May was less than half of what it had been in April. Even allowing for the fact that an estimated 103 ships totaling 244,000 tons were sunk by mines in April and May,* it is clear that the decline in ship passages through Shimonoseki during that period must have been largely caused by the immobilization of ships and by their diversion to other routes--both effects of the blockade.

After the middle of May, much of the mining effort was devoted to closing the ports along the northwestern coasts of Honshu and Kyushu. But some of the earlier targets continued to be remined, including the Shimonoseki Strait, which was closed to shipping for five whole days in June. The Japanese had to abandon the principal port of Moji, as well as the anchorages at Matsue and He-saki. Henceforth shipping was forced to anchor in the swift current of the strait or at unprotected anchorages outside. Some of the better Honshu and Kyushu ports also had to be given up.

The paralysis of Japan's maritime traffic reached catastrophic proportions in the last six weeks of the war. Between 1 July and 14 August, Shimonoseki was completely closed for sixteen days, and on many other days only a single ship or two could get through. Traffic at the ports of Kobe-Osaka had shrunk from 320,000 tons in March to 44,000 in July,⁽¹⁾ while many other ports could no longer be used at all.

By that time the food situation had become so critical that Japan had to make desperate efforts to bring in food from the Asian mainland. She could no longer try to save what was left of her vanishing merchant marine. Ships had to run the blockade at any cost. This meant not only braving the minefields but also risking being sunk by aircraft or submarines, which had joined the attacks on merchant shipping in the Inner Zone. This explains why, despite the greatly reduced traffic, ship losses in July reached the staggering total of almost one half million tons, of which close to 200,000 tons was credited to mines.⁽⁴⁾

* See Table 8.

Since we know that ship sinkings and ship immobilization both played their part in the reduction of Japan's maritime traffic, but do not know which contributed more, the only safe conclusion is that neither goal should have been pursued at the neglect of the other. Another lesson that emerges is that the relative importance of the two goals changed over time, and that the mine planners therefore should have changed their emphasis and tactics accordingly.

There is no indication that this was recognized. The campaign tactics did not take into account the early Japanese reaction to the mining, when shipping through the mined areas was suspended while laborious and prolonged minesweeping operations were carried on. At that time it would have paid to concentrate on maximizing the enemy's difficulties in clearing the mines, instead of trying to sink as much ship tonnage as possible. This was one instance when the two goals--ship sinkings and blockade--really were mutually exclusive. If it had been realized that in the early stages of the campaign the more lucrative objective would have been to prolong the immobilization of enemy shipping, the mine settings might have been chosen so as to sink the small, shallow-draft minesweeping vessels instead of setting the mechanism so as to inflict selective damage to the largest ships. *

Mining experts undoubtedly could point out other changes, not only in the mine mechanism but in the combination of mines used, in the location of the minefields, in the mining pattern, or in the delivery tactics that would have made the mine-clearing effort more difficult for the Japanese and therefore kept shipping immobilized for longer periods. To mention only one example, minelaying tactics could have been devised so as to hamper the activities of the Japanese mine spotters, who played an important role in the enemy's countermeasures effort. **

Measures aimed at defeating the minesweepers would have had the greatest payoff during the early part of the campaign, but they could have been pursued with profit even during the period when ship sinkings had become a more lucrative goal. Despite their pressing need for

* See p. 64.

** See pp. 48-49.

imports, the Japanese continued almost to the end to reduce shipping through mined areas until channels had been swept and allowed only the most urgent traffic to proceed. The harder it could have been made to clear the mines and thus prolong the temporary periods of ship immobilization, the greater the loss in potential ship-days of traffic.

Our discussion so far has dealt with the two principal causes of the disruption of Japan's maritime traffic, ship sinkings and blockade. But their combined effect was not the sole contribution of the mining campaign. It had indirect effects as well, which were further enhanced by the strategic bombing attacks and by other Allied operations that were independent from, and rarely coordinated with, the mining campaign. The paralysis of Japan's merchant shipping was the synergistic result of all the operations mounted against the Empire, each of which had multiple and often mutually reinforcing effects.

One factor that played a major role in the decline of Japanese shipping capacity was the shortage of fuel. It cannot be credited to any single operation, such as the mining campaign, since it represented the cumulative effects of the Allied offensive against Japan's fuel supply on many different fronts and by different means, including the mining. The impact of the fuel shortage on Japanese shipping became critical in the later stages of the war when much of the short-haul merchant ship traffic was carried by wooden ships (*kihansen*) which could be built more easily and had a better chance of escaping destruction than the larger steel ships (*kisen*).^{*} The distillate fuel used by the *kihansen* was in specially short supply and was often preempted by military users who enjoyed higher priorities.^{**} There is no

^{*} Most of the large, oil-burning steel ships had been commandeered by the Army and Navy earlier in the war and had become casualties of the Allied campaign against enemy shipping. The steel ships that were still left to ply the waters of the Inner Zone in the spring of 1945 were coal-burners or had been converted from oil to coal. Japan had adequate coal reserves but not enough shipping capacity to transport it where it was needed.

^{**} Incredible as it may seem, the Japanese maintained three separate and virtually independent shipping pools that were controlled, respectively, by the Army, the Navy, and the Shipping Control Association for Merchant Shipping. This system often caused ships belonging to one pool to sail in ballast while badly needed cargo destined for a different

information available on the total number of ship-days lost while waiting for fuel, but it must have been high. Among the fragmentary evidence we have is an estimate by the Japanese Shipping Control Council in Moji that in April 1945 the shortage of distillate fuel caused 3544 ship-days of delay in *kihansen* alone, and 4266 ship-days of delay in June.*

The depletion of Japan's merchant marine was aggravated by another shortage that was at least partly caused by the mining campaign. Ships that had suffered partial damage which could have been repaired quickly were kept out of action for long periods, or even for the duration, because there were not enough repair facilities available. Eighteen of Japan's twenty-one major ship repair yards were located behind the mine barrier on the Inland Sea or on the east coast. The latter were practically inaccessible to shipping on the west coast, to which much of the waterborne traffic had been diverted after the mining of the Inland Sea. Some yards had been put out of action by the B-29 bombing attacks on Japanese port cities. The few that had remained intact, and to which access was still possible, were overloaded with work and had to cope with material shortages as well as with labor absenteeism caused by fear of the bombing attacks. These difficulties caused even lightly damaged ships to be kept out of circulation as effectively as if they had been sunk.

There is no evidence that this important fact was appreciated by the planners of the mining campaign, and some indication that it was not. For the planners not only concentrated on sinking the largest ships but also used tactics designed to inflict the maximum damage to the target ships.

It was therefore concluded that a narrow target width was desirable in order that maximum damage be done to each ship actually mined. A delay of a few days or weeks in

pool had to wait on the docks for cargo space in a ship of the right pool. The three pools competed for scarce necessities, especially fuel, with the merchant ship pool usually coming out the loser. It was not until May 1945, when it was already too late, that the three separate pools were consolidated under the central authority of a joint board representing all using agencies (Ref. 4, p. 88).

* Reference 4, pp. 90 and 92.

the firing of mines in the channel caused by the smaller threat of firing resulting from narrow target width could be tolerated in order to obtain maximum mine effectiveness. The smaller target widths also advantageously decreased the efficiency of enemy sweeps.*

This practice undoubtedly increased the "body count" of ship tonnage sunk or severely damaged but probably at the price of keeping fewer ships out of action than if the planners had been satisfied with lighter damage. Given the condition of the Japanese ship repair yards at the time, the desire to achieve maximum damage appears to have been a case of overkill. We do not know, however, whether this condition was known to the mining force or whether any effort was made to single out repair yards or other port facilities as a specific target for bombing, and to coordinate such attacks with the mining campaign.

The lack of evidence seems to argue that such coordination would have been the exception rather than the rule. The damage that the Japanese ports sustained from the B-29 bombing attacks was a by-product of the strategic campaign against urban-industrial areas. Yet it contributed substantially to the disruption of Japan's maritime traffic, since the destruction of repair and loading facilities lengthened turnaround time and thus caused potential ship-days of traffic to be lost. But in some cases the destruction was redundant, for the ports already had been rendered inaccessible by the minefields. Hindsight suggests that the closure of Japanese ports, and the consequent paralysis of shipping, could have been accelerated if the mining and bombing of ports had been carried out as a single, coordinated offensive, with the bombers concentrating on ports that could not be reached by the mines.

These instances of failure to coordinate different forms of attack that could have been made mutually reinforcing, if their interdependence had been exploited, unavoidably resulted in a certain amount of wasteful duplication and overkill. One is left with the impression that each of the forces deployed in the Pacific planned and fought its own separate war, without much regard to its effect upon, or its possible

* Reference 2, p. 10.

benefits from, other operations that served essentially the same objective. This might be expected where different nationalities, different arms, or different commands were involved. But it occurred even within the same organization, as in the case of the bombing and mining of ports, both of which were done by units of the XXI Bomber Command.

The tendency to go it alone is mentioned here, not to detract from the undisputed success of the closing campaign against Japan, but because it suggests an important lesson for the future. The final phase of the Pacific war was a war of abundance; the Allies could muster more strength than was needed to defeat Japan and could afford to kill the same target several times over. A future conflict, especially in its early stages, could be a war of scarcity in which wasteful practices might prove disastrous.

VI. IMPLICATIONS FOR THE FUTURE

The lessons of the B-29 mining campaign will be found throughout this report. A few are briefly recapitulated here because they have special implications for future planning.

THE FUTURE POTENTIAL OF OFFENSIVE MINING

The role that the B-29 mining campaign played in the defeat of Japan was made possible by circumstances that may not recur. But just as the opportunities offered by such a campaign were not foreseen prior to the war, we may now be equally unable to foresee new uses for offensive mining in future conflicts that could be very different from those we have known in the past.

As demonstrated in World War II, aerial mines are an effective complement to the more familiar instruments of strategic and tactical air warfare. Under certain conditions, however, they may not only complement the familiar weapons of airpower but serve as a substitute for them. The mining of Haiphong Harbor in 1972 was a case in point. At that particular time, the interdiction of North Vietnam's shipborne imports by other means was precluded by political considerations.

The awesome power of modern weapons, nonnuclear as well as nuclear, has fostered a growing trend toward restraint in their use. There is a need for less destructive means to achieve the limited objectives that are likely to be sought in future conflicts. One of the few safe predictions about the future is that if mankind is to escape destruction, wars involving the superpowers will be fought under political constraints more severe than those imposed on U.S. armed forces in Korea and Vietnam.

In these circumstances, the traditional forms of aerial warfare could be regarded as too provocative or too escalatory for safe use. Occasions may therefore arise when, in order to restrict the level of violence, offensive mining may be chosen as the preferred, or the only politically feasible, means of inhibiting enemy traffic and resupply.

Some hypothetical examples of such situations are presented in another Rand study.*

That conflicts of this type should be given serious consideration is demonstrated by recent events in the Middle East. If they were to occur, and the United States became directly involved, aerial mines could prove an even more essential weapon than they did in World War II, although they might be used on a different scale, in different circumstances, or for different purposes.

MINES ARE STILL ORPHANS

The success of the B-29 mining campaign did little to change the low esteem in which mining has always been held. Yet we saw that this attitude was responsible for many of the difficulties that the proponents of aerial mining faced in World War II, and that it often prevented the potential of this form of warfare from being fully exploited.

There is no indication that the importance of offensive mining is any more widely recognized today, either in the Navy or in the Air Force, than it was during World War II.** What is being done now to prepare for future mine warfare appears to be again mostly due to the efforts of a small group of dedicated mining enthusiasts who are trying against odds to keep the state of the art alive.

The nature of these modest activities suggests that what contingency plans there are for the future use of aerial mining may be oriented primarily toward the support of ASW operations in a major war. If this is the case, it would indicate a neglect of other strategic and tactical uses of offensive mining in more likely types of conflict in which aerial mines could provide a unique capability. The importance of preparing for such uses was indicated in Sec. V.

If the occasion for offensive mining does arise, the Air Force probably will be charged with the main burden of delivery, especially

* J. W. Higgins and H. A. DeWeerd, *Land-Based Air, Sea Mines and Maritime Interdiction: B-52 Capabilities Illustrated in Mediterranean Limited-War Scenarios*, R-1251-PR, July 1973 (Secret).

** This impression is shared by other Rand colleagues who have examined the present mine-warfare capabilities and activities of the U.S. Navy and the U.S. Air Force.

if the mining requires a sustained effort on a large scale or over long distances. At present, USAF B-52 aircraft represent the only readily available capability for this task. But apart from the fact that the generally low regard for mine warfare is shared by both services, the Air Force is further handicapped by the fact that the overall responsibility for the planning and conduct of mine warfare is assigned to the Navy. The official statement of roles and missions charges the Navy, as one of its *primary* functions, with "minelaying, including the air aspects thereof, and controlled mine field operations." The Air Force is merely given the *collateral* functions "to train forces ... to conduct aerial minelaying operations."*

The language of this directive is interpreted by both services as giving the Navy overall responsibility for all aspects of future mine warfare, by sea or by air, including the planning, the design of minefields, the development and procurement of mines, and their delivery, except for the assistance the Air Force may be called upon to provide in the conduct of minelaying operations.

It is likely, however, that under the "total force" concept formal mission assignments would be waived when the time comes, and that tasks will be assigned to the service having the best capabilities for performing them. The Air Force, if only because its long-range aircraft may be the only suitable means of delivery, might therefore be required to assume far more responsibility for aerial mining in a future conflict than the mission directive suggests.

This was the situation that prevailed in World War II, when mining was also regarded as the primary responsibility of the Navy, although most of it was done by air forces. The anomaly led a Navy mine-warfare expert to comment as early as 1944:

Originally mining seemed to be a Navy business. As time has passed it appears that the aerial mining phases of the work have become more and more an Army Air Force function. The Navy, it turns out, merely supplies the

* Department of Defense Directive 5100.1 (of December 31, 1953), incorporating changes through June 17, 1969.

mines and some of the technical and operational assistance. The job itself is being done by the Air Force. In spite of that situation it appears [that] Aerial Mine Warfare is still an orphan in the Air Force organization in Washington....*

If the Air Force is to be prepared for the task with which it is likely to be charged in future conflicts, it cannot allow aerial mine warfare to remain the "orphan" that it was in World War II. Nor can the planning responsibility for this mission be left to the Navy alone. Many peacetime planning aspects, beyond those concerned with the operational details of mine delivery, will require participation by all agencies of the Air Force.

A more realistic division of the mining function between the two services would go part way toward turning a marginal capability into a real one. But if aerial mining is to come into its own, it would have to be planned and prepared for in the same way as the more traditional forms of aerial warfare. This means that it must become a matter of concern to all organizations within the Department of Defense that are involved in strategic and operational planning for future conflicts. It would take more than directives from higher authority to bring about such a change. The outstanding lesson from our mining experiences in World War II is that a basic change in the military attitudes toward mine warfare would be required for this mission to achieve its proper place in our strategic thinking.

Since the B-29 mining campaign demonstrated for the first time that air power can carry the brunt of a strategic blockade of a powerful maritime nation, it is recommended that ... [it] be given careful consideration and evaluation in future military planning.**

* Another excerpt from the letter by Lt. Comdr. Kenneth L. Veth, USN, written in September 1944. See footnote, p. 14.

** Statement made at the close of the war by Lt. Gen. N. F. Twining, USA, Commanding General Twentieth Air Force. Cited in Ref. 3, p. 5.

OBJECTIVES OF AERIAL MINING

Whether ship sinkings or blockade should be the preferred objective states the problem in the wrong terms. Either could be the proper objective under certain circumstances and at certain times. Which it should be depends largely on the enemy's reaction to the mining. In most situations, both objectives would have to be pursued simultaneously, although the emphasis on one or the other might need to change from time to time.

A successful blockade, if it can be achieved, obviously will put more shipping out of action than can reasonably be expected to be sunk by the most effective mines devised. But unless he has other alternatives, an opponent will not submit to a blockade; it must be reinforced by demonstrating the penalty for defiance through ship sinkings.

The danger is that those charged with the mining operation, or their superiors, may be tempted by the "body count" syndrome to regard ship sinkings as a more rewarding payoff than ship immobilization. The results of the former can be observed more quickly, and reported more easily, than the delayed and more intangible results of the latter. An exaggerated emphasis on ship losses could lead to neglect of the possibly greater opportunities afforded by blockade.

Although the two objectives are mutually reinforcing rather than mutually exclusive, a deliberate choice between the two is often necessary for operational reasons. There the two objectives may be in conflict. The mine settings, mining patterns, minefield locations, and delivery tactics adopted in order to maximize ship losses might be different if the goal were to prolong ship immobilization by interfering with the enemy's minesweeping efforts.

The overall objective of aerial mining will be, as in the past, to inhibit the opponent's maritime traffic. But the means by which this is to be accomplished--ship sinkings, blockade, or some combination of the two--cannot be determined in advance, since that requires knowledge of the enemy's circumstances and his likely reaction to the mining. One lesson of the B-29 mining campaign is that this important factor was not given sufficient attention. "Know thine enemy" is a rule too often neglected in the impersonal wars of modern times.

MEASURES AND COUNTERMEASURES

The actual conduct of the B-29 mining campaign, which was discussed in Sec. IV, does not lend itself to a brief recapitulation. Some of the operational details will still apply in the future; others may have been overtaken by changes in the types of mines available, in the aircraft carrying the mines, and in mine delivery tactics. An effort was made in the text, however, to stress those aspects of the operation that may suggest principles for future application, although the details will often have to be adapted to the new situation.

If there is anything discussed under the conduct of the campaign that is important enough to be singled out here for further emphasis it is the problem of frustrating enemy countermeasures. Section IV dealt at some length with minelaying tactics that made the mine-clearing job easier for the Japanese, and with a variety of ways in which it could have been made more difficult.

This was not always the fault of the mining planners. They often lacked the right types or the right mix of mines or had to follow tactics that were dictated by operational necessity or convenience but were not conducive to the best results. There were other reasons as well. The lack of a clear-cut choice between the two objectives of the campaign--ship sinkings and blockade--which affected so many aspects of the campaign, also played a role in weakening the effort against the enemy's countermeasures. Perhaps even more important was the lack of sufficient attention to the manner in which the Japanese operated, not only in their specific mine-clearing operations but in what caused them to immobilize ships or allow them to proceed. The mining planners were preoccupied with the enemy's sweeping gear and sweeping tactics but did not seem to have appreciated other important factors, such as the role played by mine spotters, and the effect which certain minefield patterns and certain delivery tactics had upon the ease or difficulty of clearing the mines.

COORDINATION OF MINING WITH OTHER OPERATIONS

It was noted in the closing paragraphs of this report that there was a tendency in the Pacific, as there undoubtedly was in other theaters

and in all wars, for each of the several military organizations involved to go it alone. The strangulation of Japan's maritime traffic was the common objective of a variety of military operations, of which the mining campaign was only one. But there was little coordination among them. The total impact could have been enhanced if these separate operations had been designed so as to maximize the benefit they derived from one another. Moreover, if they had been conceived and conducted as parts of the same broad offensive, wasteful duplication and overkill could have been avoided.

The individual operations themselves often had a multiple effect beyond the immediate objective. The mining, for instance, not only caused ship loss and immobilized traffic but also contributed to the disruption of Japanese shipping in several other ways. It is not clear that this synergistic effect was fully appreciated and exploited by designing the operation so as to maximize the less obvious side effects of the mining campaign.

* * * * *

The foregoing remarks, made with the benefit of hindsight, are not meant to detract from the achievements of the B-29 mining campaign. It was a remarkably successful operation, improvised on short notice, and conducted with great skill and ingenuity in the face of the skepticism with which mining was viewed by many high-ranking officers in the theater and in Washington. What shortcomings the campaign may have had were pointed out here solely in the hope that the lessons to be learned from them may help future planners.

There is a tendency to belittle the lessons of the past because they rarely provide a clear-cut prescription for future action. It is true that history does not repeat itself, but only in the sense that specific events do not recur. The basic patterns, however, that lie behind these events and often shape them do provide a continuity that stretches from the past into the future. The purpose in assembling the lessons of the campaign has been to try and identify some of these patterns.

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